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Skyways

Flight
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Operational Applica-
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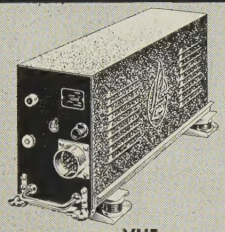
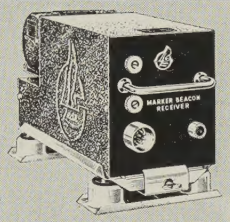
VEMBER 1954 50c

Best equipment for the beautiful new twins

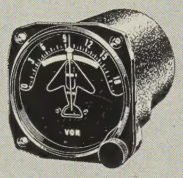
LEAR



VHF TRANSCEIVER
36 Channels—crystal-controlled



MARKER BEACON RECEIVER
Visual and Aural



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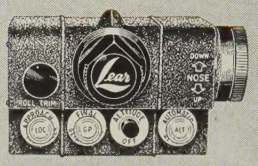
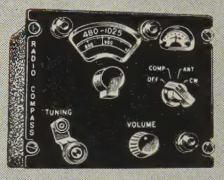
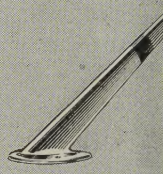


L-2 AUTOPILOT
Push-button ILS Approach and Altitude Control

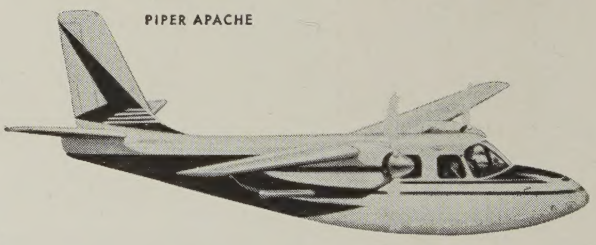


AUTOMATIC DIRECTION FINDER
Remotely Controlled

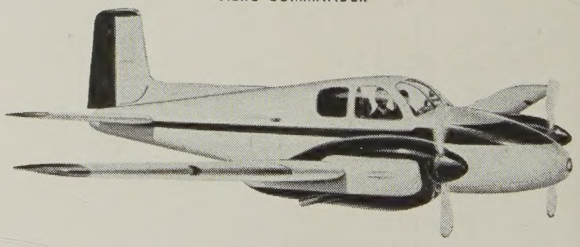


VHF ANTENNA
Broad Band Performar

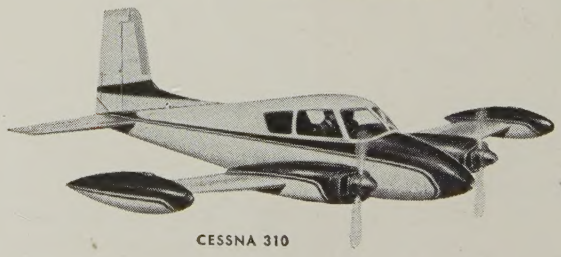
PIPER APACHE



AERO-COMMANDER



BEECH TWIN-BONANZA



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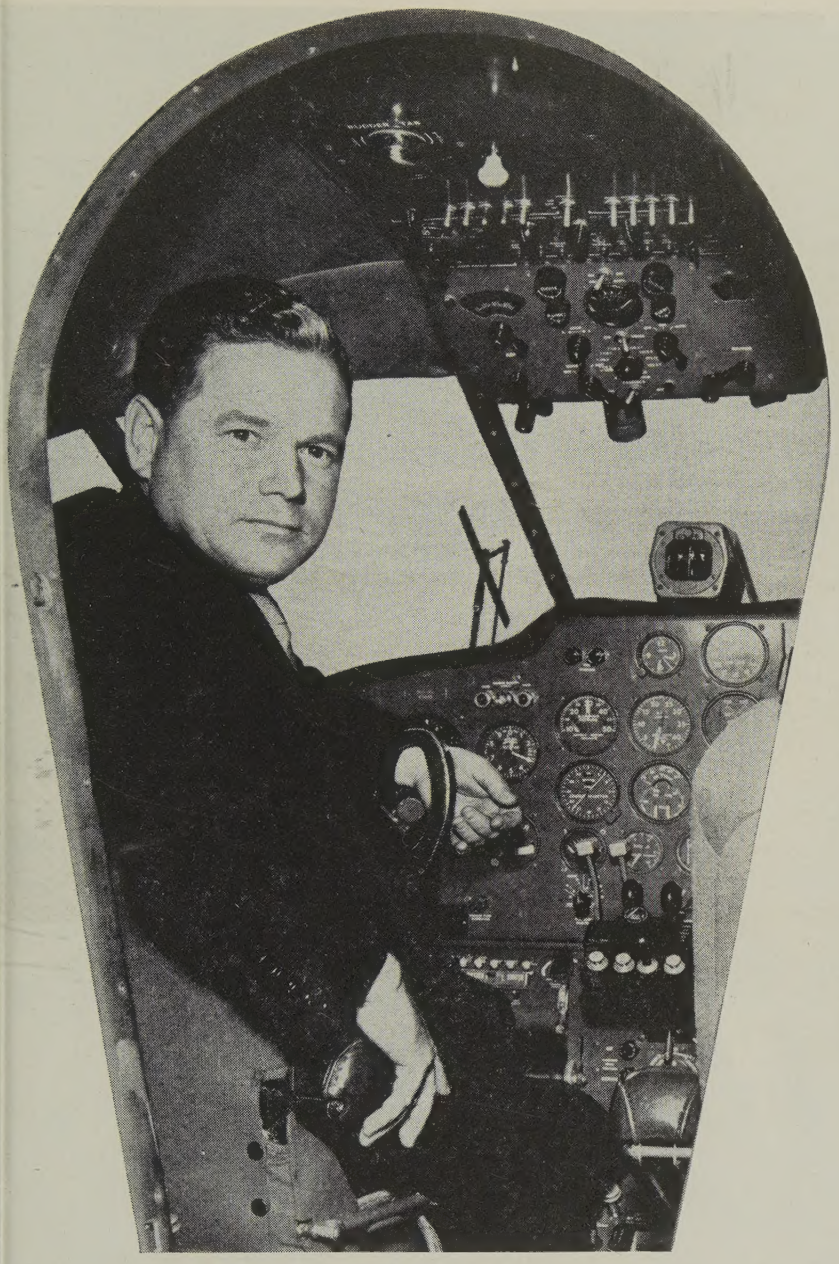
LC-13



David Feltus, Chief Pilot for J. B. Michael & Co., Inc. seated at the controls of a D18 S, Beechcraft, one of the planes he flies for his Company.

Ask the men with the most experience . . . ask

DAVID W. FELTUS

Chief Pilot for
J. B. Michael & Co., Inc.
Memphis, Tenn.

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The silent world beyond sound is the scene of battle for the Navy Tiger. Grumman's new fighter slips through the "sonic barrier" as if air at the speed of sound were smooth instead of strange. Supersonic, she can make the fastest bombers prey for her missiles, or she can make an inland city the target of Navy attack carriers. Designed also for speed of production, the Tiger was built and flown in 15 months. Tigers for carrier operations will soon be in production.

Grumman

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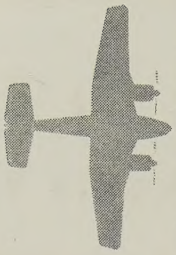
Designers and builders also of Cougar jet fighters, S2F sub-killers, Albatross amphibians, metal boats, and Aerobilt truck bodies



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NOVEMBER, 1954

Skyways

Flight Operations • Engineering • Management

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FOUNDED BY J. FRED HENRY, 1942

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industry notes . . .

■ Production of the Pratt & Whitney J-48 turbojet engine which powers the Grumman F9F-5, F9F-6, F9F-8 and the Lockheed F-94C, has been extended by the Navy. Pratt & Whitney will subcontract an unusually large amount of work on the J-48 parts because the J-48 departments at P&W already had been converted to the production of other gas-turbine engines. Delivery on the new J-48 order will begin in 1955.

■ The first two production models of the C-123B *Avitruc* assault transport (*see cover*) to roll from the Fairchild Aircraft's final assembly lines have been delivered to the Air Force. The aircraft presently are undergoing performance, stability and control tests at Edwards AFB, California.

■ A new fuel test laboratory building is under construction at the Wright Air Development Center, Dayton, Ohio. Engineers at WADC report the building will be used to test new and improved aircraft fuels and will contain 12 safety features designed to prevent explosions, fires and injuries to personnel.

■ The United States has placed a $103 million order for Gloster *Javelin* and Hawker *Hunter* aircraft for USAF headquarters in Weisbaden, Germany.

■ Transcendental Aircraft Corporation's Model 1-G Convertiplane recently made several vertical flights. This convertiplane is a single-place research craft powered by 160-hp Lycoming engine. Engineering test pilot for Transcendental is N. N. Van Nostrand, a former Air Force pilot.

■ The USAF's Tactical Air Command has taken delivery on its first North American F-100 *Super Sabres* and soon will have squadrons of them. An additional order in excess of $100 million for the F-100 establishes North American's Columbus, Ohio plant as a second source of production for this fighter.

■ A contract to design and build a turboprop Simulator for the Lockheed C-130 has been awarded the Electronics Division of Curtiss-Wright by the Air Force. Curtiss-Wright already has delivered or is building Simulators for the DC-6B, the Convair 340, the Boeing 377, B-52, and the B-50, the Convair B-36, the McDonnell 2F9, the Douglas C-124, the Fairchild C-119 and the Boeing C-97.

■ Pacific Airmotive Corporation has signed a service agreement with McDonnell Aircraft. Under terms of the agreement, PAC furnishes skilled personnel to handle servicing and maintenance of McDonnell's F-101A twin-engine jet fighter during its experimental flight test program at Edwards AFB.

■ Contracts in excess of $7,000,000 have been signed by Ryan Aeronautical Company's metal products division. The contracts for aircraft components and jet engine parts were awarded Ryan by Douglas, Boeing, Bell, General Electric, Ford, Pratt & Whitney and Wright Aeronautical.

■ United Air Lines recently announced completion of PB-10A autopilot coupler installations on 64 of its DC-6's. Cost of the installation has been given as more than $630,000. The PB-10A is manufactured by Eclipse Pioneer.

■ Aerodex, Inc., recently was awarded another contract for the overhaul of a quantity of R-2600-29A engines. This Air Force contract will follow without interruption Aerodex current AF contract. Thus far, the company has overhauled over 2,000 Air Force engines.

■ An arrangement recently was completed between Spartan School of Aeronautics and Slick Airways which will enable Flight Engineering students from Spartan to obtain actual "in flight" experience on Slick's regularly scheduled flights. At the completion of the ground and flight instruction, the Spartan student will be able to qualify for his CAA Flight Engineer Certificate.

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Next time you land at Miami's International Airport taxi directly to the 20th Street area and the Aerodex Customer Service Terminal where courteous service — plus a hearty welcome—is yours!

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new **ARC** course indicator puts two instruments in ONE!

ARC #16706

Now users of the light, compact A R C Type 15D navigational receiving equipment can employ a single panel instrument that performs the work of two units previously used. The cross-pointer meter and the course selector have been combined into one part that fits a standard 3⅛" instrument hole. This saving in instrument panel space is important, particularly now that dual VOR installations are so popular. In addition to the space saving, installation costs are cut. Ask your dealer to specify the new #16706 Course Indicator as part of your 15D Installation—whether single or dual. The indicator may be purchased separately for use with older Type C and D equipment. Write for complete data.

Aircraft Radio Corporation

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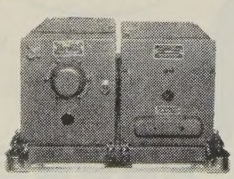
TYPE 15D EQUIPMENT

For Airborne Reception of

- **Omni-Directional Ranges**
- **Visual-Aural Ranges • Runway Localizers • GCA Voice**
- **Simultaneous Voice**



R-13B Receiver with D-10A Dynamotor
B-13 Converter, E-14 Rack and M-10 Mounting

C-22A
Control Unit,
M-18 Mounting

A-13B Antenna

now hear this . . .

PERSONNEL

Capt. Charles Antoniak, USN (ret.), has joined Solar Aircraft Co. as engineering consultant on powerplants.

Lawrence D. Bell has resigned as general manager of Bell Aircraft to devote his entire attention to his duties as president. **Leston P. Faneuf** succeeds Mr. Bell as general manager, and **William G. Gisel** takes over as secretary of the company, the position formerly held by Mr. Faneuf. **Edwin J. Ducayet** has been named assistant manager of Bell's Texas Division.

Dr. K. C. Black recently was named head of Raytheon Manufacturing Company's communications engineering department.

M. Barry Carlton has joined Magnavox Co. as general manager of the company's defense products division at Fort Wayne, Indiana.

Leland C. Launer, executive vice president of Fletcher Aviation Corp., has been elected president and chairman of the board of The Fletcher Foundation. Other directors elected were **Mrs. A. S. Fletcher, Philip W. McLane, Gerald G. Marugg, Jr.,** and **Gen. John K. Cannon.**

J. Nelson Kelly recently joined Lear, Inc., as Division General Manager of the Aircraft Service Division. **Harry Sosnoski** has been named Senior Washington representative of Lear, Inc., and **Donald W. Cook** has been named California Industrial Relations Manager of Lear, Inc.

John W. Morrison was appointed comptroller of the Aeronautical Division of Minneapolis-Honeywell Regulator Co.

Laddie L. Stahl has been named Manager of Products Planning for General Electric Company's Guided Missiles Dept.

F. A. Brown, assistant general manager of passenger service for United Air Lines, has become assistant to the vice president-transportation services, Denver operating base; **Peter Burfening** replaces Mr. Brown as assistant general manager of passenger service; **D. S. Fowler** is now administrative assistant—personnel management for ground services; **D. G. MacDonald** has become performance and controls manager—transportation services; **S. R. Wallace** has been named facility planning manager—transportation services; and **R. F. Dorsey** and **H. W. Furman** have become managers of station operations. **W. H. Maxwell** has become manager of ground services at LaGuardia Airport, N.Y.

R. H. Smith, air traffic control specialist, has been appointed Assistant to K. Matucha, manager of ATA's Central Region Office in Kansas City.

George R. Lawrence recently was named manager. Air Force Dept., of Sperry Gyroscope Co. **Thomas W. Melia** was named manager of the Army Dept.; **F. H. Jacobs** was appointed policy and planning supervisor; **Gerald B. Wright** was appointed assistant manager for research and development, AF Dept.; **V. F. Acri** was named assistant manager for production, AF Dept., and **R. C. Lyons** was appointed assistant manager, Navy Dept., of Sperry.

Robert G. Francis has been promoted to manager of production engineering and material for Marquardt Aircraft Co.

Robert M. Benson has been named vice president of Gyromechanisms, Inc., in charge of the West Coast Division.

Edward Glodeck recently was appointed Manager of Product Planning for the Jet Engine Dept. of GE's Gas Turbine Division.

Robert G. Hoch has been made manager of the New York region for the Aeronautical Division of Minneapolis-Honeywell Regulator Co.

R. Glenn Archey has been named Interline Sales Manager for Central Airlines.

Frank T. Gain has been appointed Sales Manager of Airdesign, Inc., Upper Darby, Pennsylvania.

Otto E. Kirchner has joined Boeing Airplane Co., an an engineering supervisor of commercial aircraft studies.

HONORS

Walter A. Spivak, North American Aviation's chief project engineer, recently was awarded the Outstanding Achievement Medal of the University of Minnesota's Department of Aeronautical Engineering.

Harald T. Friis, Director of Radio Research, Bell Telephone Laboratories, was named recipient of the Institute of Radio Engineers Medal of Honor, the highest technical award in the radio engineering profession.

COMPANIES

United Air Lines has signed a contract with Douglas Aircraft Co. for the purchase of 17 four-engined passenger and all-cargo planes. The $22,300,000 order calls for two 58-passengers DC-7's; ten 58-passenger DC-6's; and five 15-ton capacity DC-6A all-cargo planes.

Convair Division of General Dynamics Corporation has been elected a member of the Radio Technical Commission for Aeronautics.

CALENDAR

Nov. 4-5—Airborne and Navigational Electronics, East Coast conference. Sheraton-Belvedere Hotel, Baltimore.

Nov. 8-9—NATA annual convention. Biltmore Terrace Hotel, Miami Beach, Fla.

Nov. 9-12—Air Line Pilots Association convention. Sheraton Hotel, Chicago.

Nov. 11-12—Airmail Pioneers, division reunion. Hollywood Roosevelt Hotel, Los Angeles.

Nov. 15-17—Aviation Distributors and Manufacturers Association annual meeting. Mayflower Hotel, Washington, D.C.

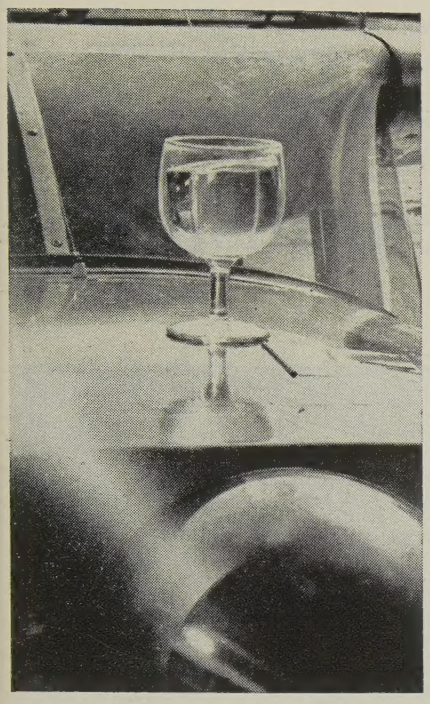
Nov. 17-18—California Association of Airport Executives fall meeting. Hotel Sainte Claire, San Jose, Calif.

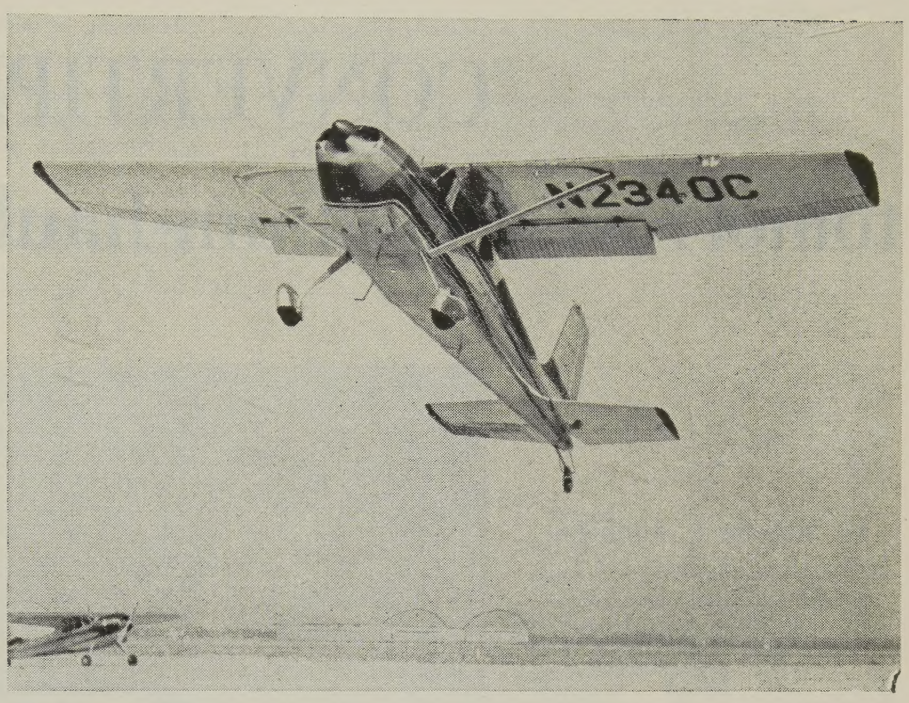
Nov. 29-Dec. 3—ASME, Aviation Div., annual meeting. New York.

Nov. 30-Dec. 3—American Rocket Society annual meeting. Hotel McAlpin, New York.

Dec. 17—Wright Day Dinner. Statler Hotel, Washington, D.C.

Smooth Power... Big Lift





- New Cessna 180 Gets Off Quickly, Cruises Quietly With 4 Passengers And Luggage
- Out-Performs Any Other 4-Place Airplane—Yet, it's Priced $6000 Under Competition!

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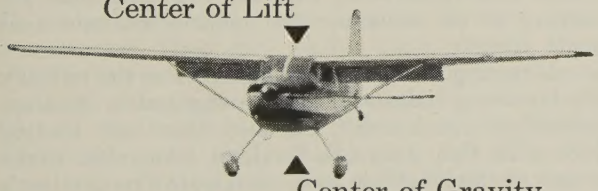
Now, Cessna 180 challenges comparison! Offers you faster take-offs . . . shorter, slower landings . . . longer range with a greater load . . . more stability . . . better high-altitude performance, than any other 4-place airplane on the market! PLUS smoother, quieter performance, *over* 150 m.p.h. cruising speed, full 4-place comfort, sparkling new colors and styling, dozens of new improvements. Yet the powerful 1954 Cessna 180 is priced at only $12,950—actually $6000 under its nearest "over 150 m.p.h." competitor! See and fly the new Cessna 180 at your nearest Cessna dealer's today (he's listed in the yellow pages of your telephone book). For more information, write CESSNA AIRCRAFT CO., DEPT. S-12, WICHITA, KANSAS.

Center of Lift



Center of Gravity

High Wing—Soft Ride

With Cessna 180 high-wing design, center of lift is *above* center of gravity, providing greater stability, smoother flight, freedom from pitching and rolling. High wing also protects you from sun heat and glare, improves your view. Extra soundproofing has been added and the Cessna 180's large heating-ventilating system (6 outlets and defroster) keeps cabin temperature comfortable regardless of altitude or weather.

New "Easy Access" Luggage Door

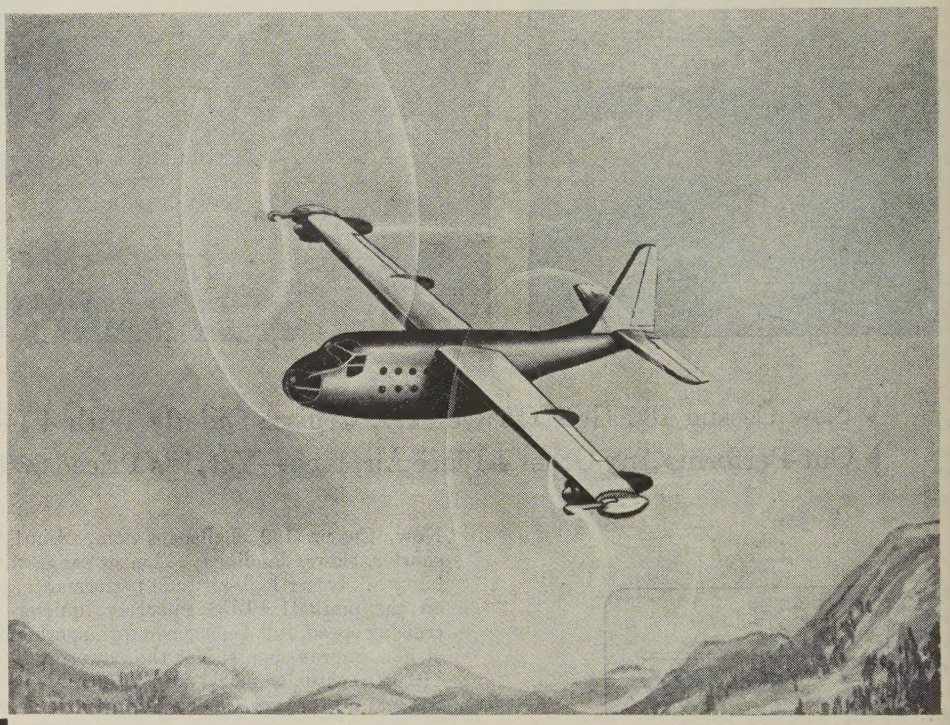
Conveniently located on the pilot's side. You can load from the inside, too! Large compartment holds 120 lbs. of luggage. Or, by removing the rear seat, you can load 500 lbs. of cargo in the Cessna 180! Optional equipment for the 180 includes skis, floats, provisions for ambulance, photographic and crop-spraying work.

4 GREAT CESSNAS 170 180 195 310 THE COMPLETE AIR FLEET FOR EVERY BUSINESS NEED

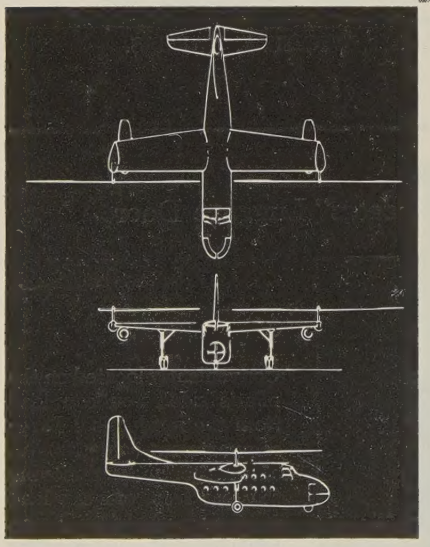
CONVERTIPLANE: tomorrow's medium-haul transport?

By Robert L. Lichten

Chief Experimental Project Engineer
Bell Aircraft Corporation
Helicopter Division



BELL XV-3, *tilting-rotor craft, is now in prototype stage. Rotor-props are mounted near tips of fixed wing. Conversion from rotor to prop is a smooth, gradual operation which is completed in from 10 to 15 seconds*



The convertiplane—a cross between an airplane and a helicopter—is rapidly becoming a reality. Designed to combine the best features of the fixed and rotary-wing aircraft, convertiplanes are considered *the* answer to the economic and tactical limitations of today's conventional aircraft.

This recognition is coming not only from engineers of the military services and the rotary-wing industry, who are engaged in developing these unconventional new aircraft, but also from such leading aviation authorities as Lt. Gen. James H. Doolittle, who refers to the convertiplane as one of the brightest spots anticipated in aviation's next 50 years and says that they should become a practicability within the next few years.

Others like Larry Bell, aviation pioneer and president of Bell Aircraft Corporation, are even more positive in their predictions, saying that convertiplanes will capture a sizable portion of the medium-haul transportation market within the next five to six years.

Based on our extensive research and development work on the XV-3 tilting-rotor craft now in prototype stage at Bell's Texas Division, the convertiplane will be able to meet a long-standing requirement never before fulfilled in the history of aviation. For finally here is a craft that can take off in an area no larger than itself and, once in the air, fly at speeds of 250 mph-plus.

The transport helicopter's economic future lies in passenger and

The convertiplane's economic future lies in passenger and cargo flights in the 100- to 750-mile range, according to Mr. Lichten. He predicts that, if its development is pursued, the convertiplane will:

- **Make air transportation available to practically every city in the world.**
- **Serve an ultimate annual passenger market of 28,000,000 persons who make trips between 150 and 600 miles, and capture a sizeable portion of that market in the next 6 years.**
- **Provide an average speed some 50 mph faster than the next best transportation in the 600-mile range, and make possible a time saving of 45 minutes in that distance.**
- **Establish (in a four-place configuration) a per-mile operation cost that will be 70% of that of an equivalent helicopter.**
- **Make possible power loadings in the 5- to 10-lb. range, compared with helicopter loadings in the 7- to 13-lb. range.**

cargo flights of up to 150-mile stage length; the convertiplane's, from 100 to 750 miles, and the airplane's, from 600 miles up. Thus, the helicopter and the convertiplane complement each other and neither completely eliminates fixed wing operations. Rather, by overlapping at their individual operating fringe areas, they augment one another to give the air-traveling public the most complete and efficient door-to-door service possible. And there definitely is a market for all.

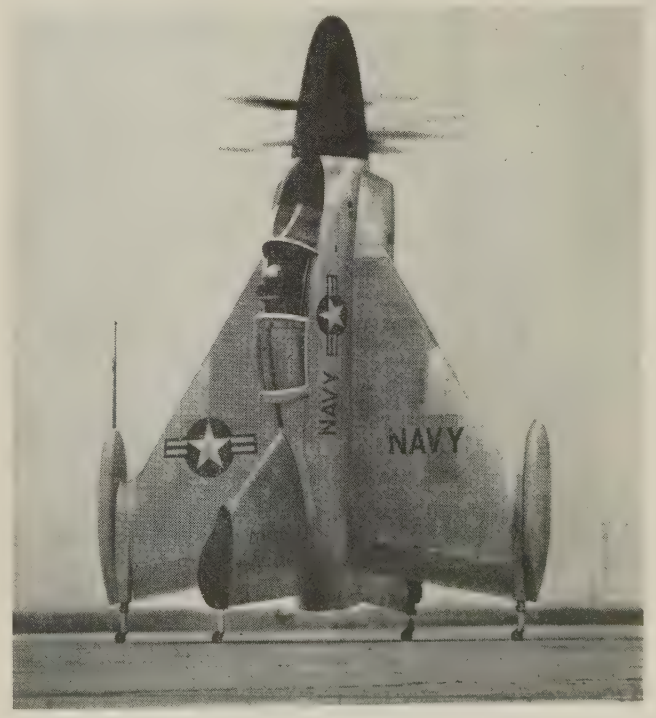
Convertiplanes, for instance, can count on an annual passenger market of almost 28,000,000 persons who make inter-city plane, bus or train trips of between 150 and 600 miles. In this range, *Figure 1 (page 10)* shows that a convertiplane provides an average time savings of 45 minutes from city center to city center compared to the next best form of air transport currently available. Speed-wise, *Figure 2 (page 38)* shows the convertiplane averages about 50 mph faster than the next best air transportation over this range. The calculated values and assumptions used for this study are given in the table, and are believed to be quite reasonable.

With all the publicity being devoted to convertiplanes, vertical-take-off craft, helicopters, channel-wing designs and boundary-layer-control airplanes, there is considerable confusion both outside and within the industry. This confusion results from both the variety of vertical-take-off craft currently being publicized and the non-technical manner (often necessitated by military security regulations) in which the information is being presented. The public possesses no yard stick with which to measure and delineate one from another and weigh them according to their advantages and disadvantages.

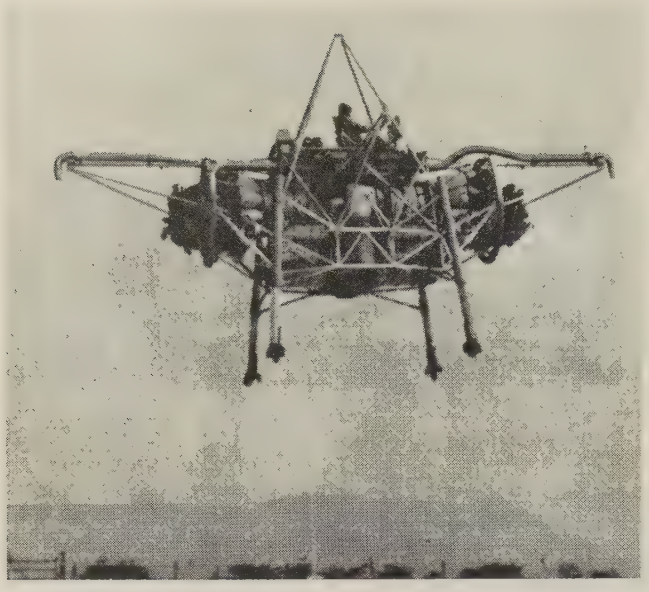
Generally, it can be said that the helicopter, the convertiplane and VTO craft are all vertical-take-off aircraft. This one performance characteristic is their common denominator. How they derive their vertical thrust—whether by rotor blades, converting rotor-propellers, conventional counter-rotating propellers or vertical thrust jets—is the frosting on the cake. And the frosting is where the mental indigestion begins, for each of these types is practical in some area of the flight spectrum, but none represents the sole solution as pictured by some press releases.

For example, visualize a large VTO passenger liner experiencing a power failure while descending tail first—and depending on a parachute to avoid a crash landing. It isn't a picture likely to promote confidence in this new form of air transportation.

Now, in its place, conjure up a scene with a 40-passenger tilting-rotor convertiplane coming in for a landing—which would be made in the normal horizontal flight attitude—with all power off. Like its cousin the helicopter, this type convertiplane can execute an autorotation landing as a normal maneuver. In this case, a considerable



HELICOPTERS, *such as this twin turbo-rotor Kaman HTK-1 (above), VTO craft, such as the Convair XFY-1 (below), and convertiplanes are all vertical take-off aircraft, and this one performance characteristic is their common denominator. How each derives its vertical thrust, whether by rotor blades, counter-rotating props, vertical-thrust jets or converting rotor-props is incidental to this fact*



BRITAIN'S *"Flying Bedstead" is vertical take-off craft having no wings or rotors and is powered by two jet engines. Note fore and aft position of its jet engines. It recently made its first flight*

safety advantage over conventional transport airplanes is obvious to the passenger.

Basically, there are two types (variations) of vertical-take-off craft under development by the government: the VTOL fighter and the convertiplane. VTOL fighter designs obtain direct lift by acceleration of relatively high velocity, using turbine-driven props, jets or rocket propulsion. This requires high power output per pound of lift. The (helicopter-type) convertiplane obtains direct lift by accelerating a relatively large mass flow of gas (air) to relatively low velocity. This results in a relatively low power output required per pound of lift.

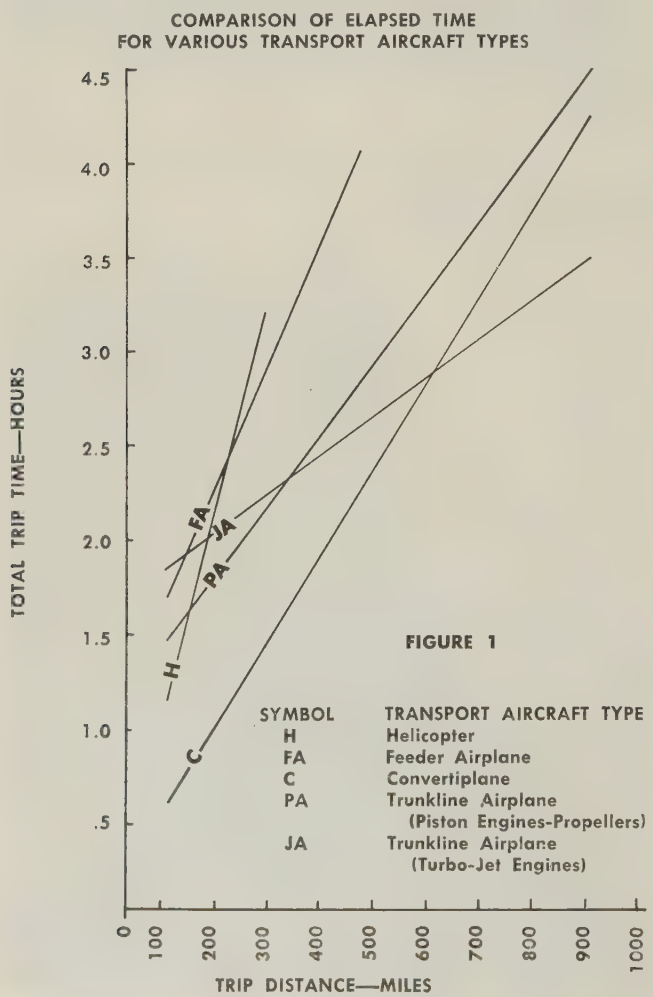


FIGURE 1

The modern propeller-driven airplane is usually designed for a range of power loadings from 5 to 15 pounds of gross weight per maximum continuous horsepower, depending on performance requirements. Modern helicopters fall in the power loading range from 7 to 13 pounds per horsepower, averaging about the same as propeller airplanes. Convertiplanes may be expected to have power loadings in the range from 5 to 10 pounds per horsepower. In contrast to these, the propeller driven VTOL fighter is estimated to require a power loading as low as 2 in order to achieve satisfactory vertical take-off performance, which means a lot of engine for a small airframe.

These two types, while similar in basic means of obtaining direct lift, differ by the engineering approaches used. VTOL fighters start with an airplane and add features to permit vertical take-off and landing. On the other hand the convertiplane originates with a good basic helicopter and adds features to provide high forward speed. To further alleviate the confusion, perhaps this type should be called converticopter.

For years airplane designers have experimented with a variety of slots, flaps, slats and snoots to help overcome the basic limitations of conventional fixed-wing airplanes. None, however, comes close to making fixed-wing planes perform with the same precise control at low airspeeds and in gusty wind conditions as provided by helicopters.

Excellent control for maneuvering in restricted areas close to the ground is another advantage the convertiplane holds over VTO aircraft. Even in the most critical periods of flight—including the conversion process itself—control effectiveness is unimpaired and the convertiplane responds precisely to the pilot's every dictation. Most VTO craft have, at best, marginal control during the delicate take-off and landing maneuver, particularly in high wind and gusty air conditions.

Summing up, the convertiplane has four major advantages over the VTO-type craft: 1) precise control, 2) psychological and mechanical benefits of normal flight attitude, 3) inherent safety feature of autorotation capabilities, and 4) lower power requirements.

In spite of these advantages many in the industry are pessimistic about the convertiplane. Recently, a leading helicopter pioneer, Igor Sikorsky, stated that the convertiplane is basically "a fairly inefficient helicopter coupled with a fair inefficient airplane."

This is not an isolated case or an unusual expression of doubt. A partial clue to the answer can be found in a definition of the convertiplane: convertiplanes are aircraft which *combine* the vertical take-off, hovering and vertical landing abilities of the helicopter with the high speed and long range capabilities of conventional airplanes.

The key word in this definition is "combine" since it raises the issue of fundamental economical soundness of convertiplanes. Many, like Mr. Sikorsky, maintain that any combination-type vehicle or any other product is inevitably less efficient than each of its components acting alone and, therefore, economically unsound in this age of specialization.

Although this is true in many cases, there are just as many examples to be found of extremely successful combine products. Take, for example, these everyday items: claw hammer, radio-phonograph, bifocal glasses, etc. It is possible to establish ten- (*Continued on page* 38)

by Louis Alexander
Houston Chronicle

MODIFIED FOR CHARTER

PBY MODIFICATION *included installation of an air-stair door for passenger convenience in land operations. Other features of this $70,000 conversion project are availability of in-flight working space (left) and installation of a divan in forward compartment which opens into a bed for two persons. The plane carries 21*

An oil company in Houston, Texas recently completed a rapid flying survey of offshore oil exploration. A few days later, in the same converted and modified PBY used for the survey, another group of oilmen flew to Canada for a well-earned hunting and fishing vacation.

Both projects were possible only through the conversion and modification of a PBY for charter work. This PBY conversion is the third in the United States, the first for charter work (the other two are owned by oil companies for their own use), and opens new vistas for the use of aircraft for projects involving heavy loads—either passenger or cargo—in areas where the water may be too rough for smaller amphibians or where a DC-3 or *Lodestar* conversion cannot roam.

The PBY was converted in Houston, Texas, at a cost of about $70,000 by the Aero Sales Division of Houston Transportation Company, a subsidiary of Trans-Texas Airways.

It has several unusual features, some of them are in the other two PBY conversions, but this conversion has two unique advantages: (1) it can carry more passengers —21—and a greater useful load at its gross weight of 28,000 pounds; (2) it has the only automatic bilge pump (it starts pumping whenever water in the hold gets as high as 1½ inches) which signals loudly so that crew members are alerted to seepage and possibly hull damage.

The automatic signaling bilge pump is considered an extra safety measure by the men (*Continued on page* 38)

PROCEDURES, *standard and emergency, are run through carefully in pilot refresher course. Pilot is Art Zimmer; co-pilot is John Kolar, both of Pickands Mather & Co. Ed Martin rides jump seat*

Packaged advisory service makes good its claim to improve flight operations by increasing safety, adding to utilization and reducing costs of company aviation depts

Custom-Tailored for Business Flying

by Eliot Tozer

Not long ago the officers of Pickands Mather & Co. in Cleveland took a long look at their growing disbursements for executive travel and wondered uneasily whether or not they should buy a company plane. It was a tough decision to make because no one on the staff was aviation wise enough to say outright, "We should buy this type plane, hire these two pilots, and rent space in that hangar."

Yet within six weeks the company had acquired a custom-converted DC-3, had hired two pilots and a mechanic, had contracted for outside maintenance engineering service, and had completed its maiden flight.

This is not too remarkable in itself—despite the speed with which the company, uninitiated as it was in the ways of business flying, had set up its new aviation department. But the following facts add up to something that *is* remarkable:

1. The plane that Pickands Mather bought was designed specifically to meet its traffic needs, *i.e.* its 1350-hp engines and 26,200-lb maximum gross weight were, for example, precisely what it needed to cruise most efficiently and to get into and out of short fields.

2. The company paid no broker's fee.

3. The DC-3 conversion was "monitored" by outside engineers from the firm that had redesigned it.

4. Test and acceptance flights were monitored by the same engineers, thus, Pickands Mather had continuity of supervision from the moment the specs for its plane were written until the plane was delivered.

5. Pilots were "guaranteed" in the sense that they had been selected by personnel men with long experience in the aviation field.

6. A complete maintenance program was set up, including a recommended service pattern for the company's own particular plane; service forms and a maintenance manual were provided—again for Pickands Mather's own particular plane. Maintenance scheduling forms were provided, and the company had the offer of assistance in solving any and all future maintenance problems as they arose.

All this at a cost to Pickands Mather of only a small percentage of the conversion cost of the airplane. In other words, Pickands Mather, as most companies do when big decisions have to be made, had hired a consulting firm whose staff members had had long experience in each of the phases of setting up an aviation department. And the firm had supervised the establishment of the new aviation department at a small fraction of the total first cost.

The name of this consulting firm—Flight Safety, Inc.—is already known to many of the pilots in the business fleet. Offices are at the Marine Air Terminal at La-Guardia Field, and the company has expanded considerably since it first opened its doors in 1951 to offer ground and flight training to executive aircraft pilots (see *SKYWAYS, Nov., 1953*).

As a consultant, Flight Safety has taken on considerable responsibility, for it actually is offering to the industry a "packaged" advisory service that covers everything from redesigning to test-flying aircraft and from assisting in the hiring of pilots to the training of them. But like all successful consultants, its personnel have the breadth of experience necessary to carry it off. For example, Al Ueltschi, president, has been the manager of Executive Transportation for Pan American World Airways since 1942. Jim O'Neal, vice president, has been an

airline pilot since 1937; in 1944, he became Assistant Chief Pilot in charge of training for the Atlantic Div. of Pan American. Ed Martin, Flight Safety's Superintendent of Training, is an aeronautical engineer and has flown as engineering test pilot for Boeing and for American Airlines; he has worked in a technical capacity for Colonial Airlines and Sperry Gyroscope Co. Mel Rummel, Manager of Maintenance Engineering for Flight Safety, was formerly senior Aeronautical Engineer in charge of Special Projects for a leading airline.

Add up such diverse and lengthy experience and you get a consulting firm that is making good in its claim to increase safety, improve utilization, and reduce costs. For these are the aims of Flight Safety, Inc. Says Ueltschi, "In our book, safety comes first, then utility, then economy."

Safety begins when the specs are written. For example, in writing the specs for the Pickands Mather plane, Flight Safety specified that, "Complete fire prevention re work recommended by Fight Safety Foundation and in accordance with CAR 4B will be performed, including firewall shut-off provisions for fuel, oil and hydraulics." All new high-shear Magna-Fluxed wing bolts were ordered. A special hydraulic unloader valve was called for to replace the engine selector valve and pressure regulator. In fact, all equipment met Section 4B requirements of the CAR Transport Category.

Flight Safety, again calling on long experience in the field, even went so far in writing the specs as to specify in many instances the actual name brand of the equipment or material to be used. Thus, all control surfaces on the Pickands Mather plane were re-covered with new fabric and then finished with Monsanto fire-resistant dope. Fire detection equipment for Zones One, Two & Three was manufactured by Edison. Flexible hose lines to the engine compartment were made by Aeroquip. The electro gyro horizon installed was the Sperry H-5. And the Radio Magnetic Indicator was Bendix #36105.

But Flight Safety's contribution to the safety of executive aircraft operation doesn't stop with writing specs. One of its major functions still is training and re-training business pilots. A function, by the way, that might have been the source of some misunderstanding in the past. There are pilots who believe that Flight Safety has been set up to fly check rides. Nothing could be further from the truth. Flight Safety's function is to provide continuous training just as the airlines and the military provide continuous training for their pilots.

At Flight Safety, pilots can take a complete refresher course in approximately seven days, covering all the fundamentals and emphasizing those aspects in which they need the most help. The syllabus includes ground and flight training and simulated flight training in electronic trainers incorporating the Curtiss-Wright Dehmel Radio Aids units.

F.S. also contributes to safer business flying by operating as a clearing house of information. It keeps its clients advised of latest factory bulletins on engines and equipment, and helps disseminate the information from CAA Airworthiness Bulletins and Alert Bulletins. The monthly Newsletter discusses new information on such phenomena as vertical jets and thunderstorms, for example, and the responsibilities of the pilot under radar control, or perhaps details regarding an unexplained rash of R-1830 bearing failures.

If pilots are planning a flight to a new field, Flight Safety suggests that they drop in to make a practice let-down; if any pilot has trouble with one particular airport, Flight Safety incorporates practice let-downs for that airport in the routine refresher.

The second of its major objectives—increasing aircraft utilization—also begins at the beginning, because efficient utilization means getting the right airplane in the first place. Here's how F.S. found the right plane for Pickands Mather.

Ueltschi and his staff carefully analyzed a DC-3, B-23, and L-18 in the light of the company's requirements as to route length, number of passengers, frequency of operation out of small airports, and operational pattern.

One of the unknowns in the analysis of the DC-3 was the engine horsepower needed. Pickands Mather's operation seemed to call for the heavier 26,200-lb Douglas, but most of the fields that the company planned to use were in hilly northern mining country—Hibbing, Minn., for example. So Flight Safety recommended installation of 1350-hp engines. With these engines the length of runway needed was less than it was with the 1200-hp configuration.

There were also additional advantages from the use of the greater horsepower engines. For example, in cruising from Willoughby, Ohio to Hibbing, a DC-3 with 1200-hp engines would take (*Continued on page* 41)

AIR TRAFFIC CONTROL *specialist, Ted MacEachen, reviews fine points of instrument let-down procedures with Capt. Jess Mosher of Henry J. Kaiser Co. Trainer incorporates Dehmel Radio Aids unit*

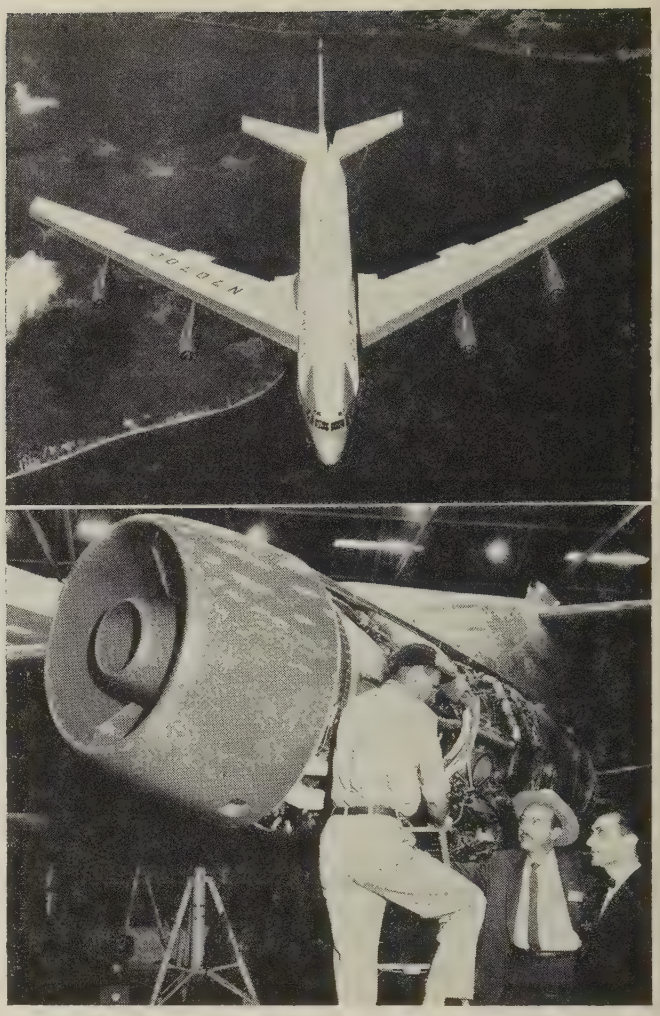
PILOTS *taking course go over subjects in discussions. Here (left to right) are Bill Moore, Tom McGill, Jim Gray of Kaiser Co., and Smitty Holder of Precision Casting Co. Instructor is Lee Ariel*

design analysis

Jet Transport Engine Location

A resumé of the design aspects of jet engine locations and their relation to the over-all design of commercial turbojet air transports

By R. W. Rummel
Chief Engineer
Trans World Airlines, Inc.



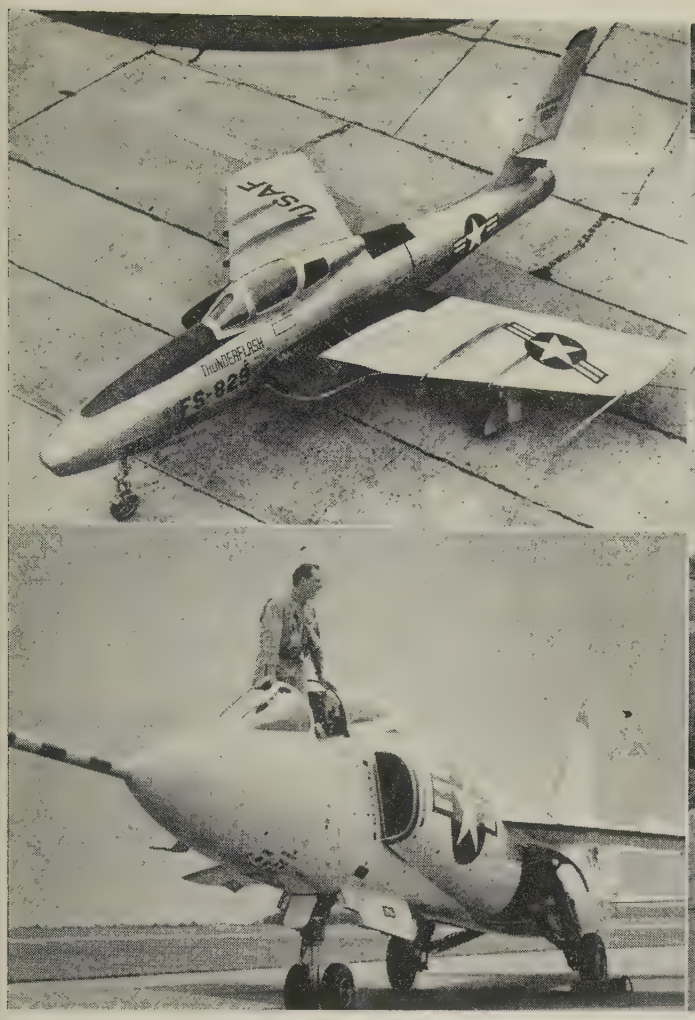
WING-MOUNTED POD *installation has been the Boeing preference in the B-47, the B-52 and now the 707 (top photo) military tanker-transport which offers possibilities as a commercial 80- to 130-passenger airliner. Powerplants are the P&W JT-3's (above)*

Development of the jet engine offers a variety of installation possibilities for tomorrow's commercial jet transports that are not possible for piston-engine transports. Jet-engine installations in military aircraft designed both here and abroad are illustrative of many of the types of powerplant installations which ultimately may be adapted for commercial-transport use. Other location possibilities, including the engine buried completely within the fuselage contour, a design not too far removed from the majority of current jet fighters, are also in the offing.

Several distinct schools of thought seem to be prevalent among the manufacturers: some prefer wing-mounted pods; others like engines submerged into the fuselage; still others prefer them buried in the wing. Sound reasons exist for each school of thought favoring its particular selection, and one could be led to conclude that each type installation is really best considering the other aspects of airplane design which have been correlated with the particular installation selected. This is not unreasonable since the powerplant installation, while a very important aspect of soundly compromised airplane design, is but one of many important design parameters. For this reason one should not consider the powerplant installation details alone when arriving at opinions and conclusions as to what the best powerplant installation really is, but must consider the true relation of the engine installation features to other design considerations and the resulting advantages or disadvantages of the over-all design.

It, therefore, appears that in order to arrive at firm and sound decisions in the matter of jet-engine location, specific and detailed aircraft designs must be considered and weighed as to relative importance. It is not the purpose of this article to do this since no actual design is available on which it is appropriate to comment. Rather, a resumé of possible design aspects of engine-installation features and their relation to over-all design are presented. In order to limit this presentation to reasonable length, only three types of installations are considered—the wing-mounted pod, engines buried in the fuselage, and engines buried in the wing. The applicability of these specific items to a specific design can, of course, be determined only by review of a given airplane design.

There are a certain number of important design aspects which should be emphasized in any transport considered to be a serious commercial contender. For example, considering the volume of inflammables to be carried aboard any long-range jet transport, it seems appropriate to take all practical means at the designer's disposal, first, to prevent; second, to extinguish; and third, to contain fires anywhere on the airplane, but more especially in the powerplants as these must be considered a primary source of such difficulties. If anything, this type aircraft should



BURIED-IN-THE-FUSELAGE *installation is the choice of North American in the F-86, Republic in its F-84F Thunderflash (top photo) and Grumman in its F9F-9 Tigerjet (bottom photo). Many consider this least-likely-to-succeed in commercial jet design*

BURIED-IN-THE-WING *installation is a feature of the deHavilland Comet (bottom photo), first jet transport to have seen scheduled service, and the Martin B-57B (top photo), a transport version of which is now in a mock-up stage at Glenn L. Martin Co., Baltimore*

have more, not less protection than contemporary aircraft.

Much has been said and written about the ugly possibility of turbine wheel explosion and the resulting aircraft damage possibilities. We certainly must agree that turbine wheels must be designed so they will not fail at any time. However, because turbine wheels are of mechanical nature and, therefore, subject to differences in raw material, tolerances in machining and heat treating, inspection techniques, service attrition, etc., perhaps designers should go beyond designing against by protecting against. Complete protection in this instance would be most difficult; however, deflection rather than containment may offer good possibilities. In any event, considering that we may hopefully see large numbers of commercial jets in the skies some day, most of which probably will be equipped with at least four engines, it seems unlikely that the law of probability will wink its eye, so to speak, and accept a perfect score on a hot whirling mass, critical by nature, such as the power turbines in jet engines. If this be sound reasoning, then it follows that some means should be provided for either deflection or containment to the extent necessary to safeguard the aircraft against the admittedly low probability of turbine-wheel explosion. Further, an important consideration to locating the engine in a projected jet air-transport design is that of attaining minimum primary structural damage in event of wheel burst.

Another suggested design requirement is to retain the engine even though the rotating mass be brought from maximum-speed condition to rest in a very small fraction of a second. Engine failures of this type have occurred, in some cases wresting engines from aircraft. Even though it is highly unlikely that a free-falling engine might strike a critical area on the ground, this contingency should be guarded against, not to mention the important consideration of possible primary structural damage to the aircraft itself resulting from energy absorption of the rotating mass. Engines should be contained, not deplaned.

Maintenance costs should be a highly important engine-installation design consideration as these costs would be accrued daily by the airlines. Relative maintenance costs, even if quite small per unit of work, could become important dollar considerations over extended periods.

Many other considerations also are of considerable importance. Some items will be quite important in a specific design; whereas, the same consideration may be of relatively little importance in another design. It is hoped the following outline will be of interest and will serve to illustrate the general points made herein, as well as point up other details. For obvious reasons, no attempt is made here to select definitely one type installation as being superior to all others.

I. BASIC SAFETY OF VARIOUS TYPES OF ENGINE INSTALLATION ON JET AIRCRAFT

A. FIRE PREVENTION, CONTAINMENT AND EXTINGUISHING

Pod Mounting Along the Wing	Buried in the Fuselage	Buried in the Wing
1. A strut isolates the engine from other aircraft structure. The strut could be relatively easily sealed so that it would be very difficult for a fire to progress from the powerplant to the wing structure.	For comparable fire protection, considerably more structural weight will be required to isolate the engines from the cabin.	With the engine installed completely within the wing structure, extreme care in design will be required to assure that fire will not progress from the powerplant to the wing structure. This will, no doubt, involve considerable additional structural weight.
2. Wide separation of engines makes it unlikely that an engine fire will progress from one engine to another if no more than one engine were installed in each pod.	With engines in close proximity to one another, there is the possibility that fires may progress from one engine to another.	The amount of separation between engines will determine whether fires may progress from one engine to another. The wider the engine separation, the less the likelihood of fires progressing from one engine to another.
3. Fuels, oils and vapors normally draining from a powerplant can be easily isolated.	Proper fuel, oil and vapor draining will be more difficult to achieve.	Proper fuel, oil and vapor draining will be more difficult to achieve.
4. Except for consideration of air bleed to occupied areas, pods appreciably lessen possible adverse effects associated with the use of toxic fire extinguishing agents.	Considerable design effort will be required to assure that adequate sealings of powerplant compartment is obtained to assure that passenger compartments are protected from the effects of toxic fire extinguishing agents.	Same as "Pod Mounting."
5. Pods present an ignition source and source of damage to fuel-tank area during crash landings.	The engines are comparatively widely separated from fuel storage areas, thus decreasing the possibility that they will be an ignition source resulting from crash landing.	Unless a crash landing involves wing structural failure, the truly buried engine should not provide an ignition source (if hot parts are cooled promptly).
6. It will be difficult to segregate inflammables and potential ignition sources in a pylon.	With good design it should not be difficult to segregate inflammables and potential ignition sources within the engine compartment.	Same as "Buried in the Fuselage."
7. See "5" above.	Widest possible separation of powerplant from main body of fuel should have distinct safety advantages during fire or crash landings.	Proximity of engines to fuel storage increases vulnerability to fire and crash damage.

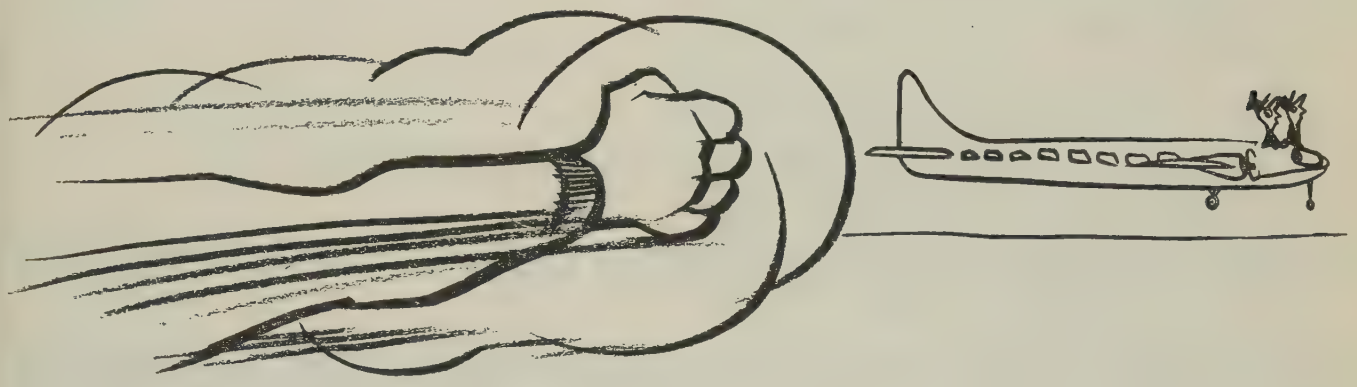
B. PROGRESSION OF FAILURE OR FIRE FROM ONE ENGINE TO ANOTHER

1. Progressive mechanical failure of engines is not likely, due to wide separation of the engines. A pod is not likely to pick up compressor blades discharged from another pod. This assumes that one engine is installed in each pod.	Depending on scoop arrangement, a greater possibility exists for progressive engine failures to occur caused by compressor blades discharged by an adjacent engine being inducted into a sound engine.	Same as "Buried in the Fuselage."
2. With the wide separation of engines there is negligible likelihood of engine fires progressing from one powerplant to another.	Depending on scoop arrangement, the possibility of progressive engine fire is greater. In addition, the aspiration effect of an adjacent engine can make fire suppression more difficult.	Same as "Buried in the Fuselage."

(*Continued on page 42*)

by Hy Sheridan
Captain, American Airlines

THAR SHE BLOWS!



I was sitting there as satisfied as a dowager's fundamental on an airfoam cushion. We were coming in to the Midway Airport at Chicago after having flown all the way from Mexico City. Indeed, I had good reason to feel satisfied, for the air had been smooth and so were the stewardesses. For a novelty, there'd been some tail wind and the engines were running like the advertisements said they did. What the first officer thought of me, he kept to himself and the engineer laughed at my jokes—what more could an airline captain want?

Why, I could even understand what the bird in the glass cage was saying on the radio, and we did not have a single near-collision around the airport, although the weather was nice and the visibility good. And then we were cleared to land on 22L, the long runway.

"How's the braking?" This was winter time.

"Braking reported good."

Ah, the life of an airline pilot! My only worry was that if the management found out how good the flight was they would charge us for the trip.

Now 22L is the southwest runway at Chicago, and the longer of the two, and the bird in the glass cage had told us that the wind was fairly strong from the south-southwest. The first officer was permitting me to practice the landing. On account of the wind I could come in with plenty of speed . . . and I did. Down to the flare-out I had a 140 mph showing on the airspeed indicator. You see, I was allowing for a wind gradient. It is a good thing that I did.

A wind gradient, friends, is a top secret. The CAA and the airline managements are keeping it on the hush-hush. No telling what would happen if the Rooskies found out about it, so you, dear reader, will kindly understand that my mentioning a wind gradient should be held quite confidential. It is a thing that causes approaching airplanes to lose flying speed on a landing glide-in and has caused no end of trouble, but nothing may be said about it. As you must know by now, the theory seems to be that *if* we officially ignore a hazard, it will get tired of hanging around and just go away.

But I allowed for a possible wind gradient. When an airline captain gets bumped off, the officials call it pilot error and send him a dozen roses. I don't like roses, so I came in with a 140 mph showing. This would also give me some time to mull over the question of where the surface of the runway was and thus make a smooth landing. This would make the first officer feel his place and add to the discipline of the ship.

So I leveled off, full of confidence if not beer, and then it happened, to borrow a phrase from Sadie the Stewardess. The bottom fell out of me. (The latter phrase is not borrowed from Sadie but is an old navy term.)

Acting purely by instinct, a thing that keeps a pilot out of trouble with an airplane and in trouble with other situations, I pulled back on the yoke with more gusto than aplomb. Up came the nose like a dancing girl with a new millionaire. And we were on the runway quick. We were stalled with a 140 mph. Now I must quote my father's famous words when he first saw me: "How can this be?"

If I had made the approach at what is naively called the normal (*cf.* Manual) speed, we would have hit hard enough to have jarred our ancestors back to the fifth generation. Modern airliners in this country are made of gasoline tanks with a little place hollowed out in which to seat the passengers and they are as ready to burn up as a Hollywood actress with second billing. It is considered *de drop* to hit the ground with one of them. (*De drop* is a French expression meaning *for the love of Pete, don't,* or *take your fat hands offen me,* depending upon the circumstances.) Anyway, it is not considered nice to crack up. That is the reason that I am writing this piece. To warn you.

The real reason that I am warning you, gentle reader, is not that I have an urge to better creation, a job that I leave to the men of the cloth and the lads who are making the hydrogen bomb, but it is because I am selfish and I don't like the prospect of losing a reader. I want to keep you in condition.

What had happened was that my Dizzy Six had leveled off in the prop wash of two big airliners. I later noticed one of them was what Sadie calls a "Consternation." The wind was south-southwest and the runway pointed southwest. Two big airliners were in Indian-file waiting to take off. They were parallel to the runway, tails to the southwest.

It is believed that one of them was running up the engines, but whether that is true or not is not of much importance. Eight big engines, even when idling, push back a lot of air and they (*Continued on page* 40)

SKYWAYS FLIGHT OPERATIONS ROUND TABLE

NOVEMBER 1954

Benjamin Franklin Hotel, Seattle, Washington

Discussion discloses turboprop transports can be economically superior to piston-engine counterparts; that scheduled operation of turbojet/turboprop is feasible

Problems in Operational Applications of Turbojet / Turboprop Transports

ROUND TABLE *participants who gathered at the Benjamin Franklin Hotel in Seattle included (sitting, left to right) Dr. C. J. Walker of GE, Wm. H. Weeks of the CAA, Dan Beard of American Airlines, Ralph Bell of Boeing, Bob Rummel of TWA, Lt. Col. J. Layson of MATS, and F. E. Davis of Eastern Air Lines; (standing, left to right) T. Sullivan of Fairchild, R. L. Wells of Westinghouse, G. C. Younie of Braniff, D. L. Elder of Douglas, G. W. Brady of Curtiss-Wright, A. F. Dernbach of Hamilton Standard, and R. H. Geary, also of Military Air Transport Service.*

R. W. RUMMEL is graduate of Curtiss-Wright Technical Institute. After serving as Chief Engineer for Ken Royce Engine Co. and Rearwin, he joined TWA in 1943. He is member of IAS and SAE.

Moderator R. W. Rummel (*Chief Engineer, TWA*):

"Gentlemen, in view of the very broad nature of our subject, we should categorize the discussion but not limit it. With your approval, I have divided the discussion into three segments:

1) Development of medium and long-range transports;

2) Development and application of short-haul or corporate-type aircraft, including the helicopter;

3) Operational maintenance and overhaul problems.

"Referring to the Number One item, let's consider the economic justification of the design, not only from the airplane market standpoint but also from the craft's payload/mph point of view. Widespread use of turbojet and turboprop transports would be impractical without operational experience with turbine-type powerplants. Experience is being accumulated by the Military with the Lockheed R7V1, the Douglas YC-124B and the Convair R3Y-1. But these are basically piston-engine aircraft to which turbine engines have been fitted. While each of these types is useful, not only as a research vehicle but also as a transport, such economic considerations as

whether or not the powerplants are optimum for the existing airframes, or vice versa, are bound to arise. If, through some happy series of circumstances, the turbo engines are ideally matched to the airframe in these instances, then significant time and development costs that would result from the creation of entirely new machines will have been saved. On the other hand, if engine and airframe are not ideally matched, is the difference of any significance?

"Mr. Elder, would you care to comment?"

Donald L. Elder (*Aerodynamics Engr., Douglas Aircraft*): "The YC-124B is an airplane that could have been produced as one competitive to anything flying today. Actually, it has been and is a useful machine for the investigation of turboprop characteristics from a cargo transport operational point of view. The experience we are now gathering will be applied to newer and better airplanes built by Douglas as well as other companies."

Ralph L. Bell (*Dir. of Sales, Boeing Airplane Co.*):

"Do you feel that the P&W YT-34 engines in the 124 are an ideal installation, or is the 124 a test bed for the engine? While it may make a very good configuration, do you consider it optimum?"

Donald Elder: "As far as the powerplant is concerned, it is not an optimum application. However, we feel that with this airplane we are able to investigate claims in powerplant performance as well as performance characteristics of the heavy cargo turboprops in general, because we can load the same type of cargo and operate on that type cruise. We know that the optimum aircraft configuration would be different and more efficient, but the 124 does provide us a means of investigating every phase of turboprop operation."

R. W. Rummel: *"Since it takes longer to develop an engine than it does an airframe, couldn't some manufacturer come along with an airframe more compatible and nearer the optimum configuration?"*

Donald Elder: "The airplane that will succeed the 124B is being developed now while we are getting experience in flying the 124B. All of this experience will go into the successor airplane.

"The industry as a whole lacks experience in the operation of turboprop transports, but the obvious superiority of the turboprop for particular applications has led us into building this type airplane before we actually know the full extent of the advantages to be realized."

R. W. Rummel: *"As I understand it, Mr. Elder, the YC-124B is considered a superior airplane when compared to its piston-engine counterpart, but it is not necessarily the optimized turboprop transport."*

Donald Elder: "That is correct. It is superior in performance and in operational costs."

W. H. WEEKS *(top, center) of CAA reported that because of increasing complexity and differences in design of aircraft no generalized set of airworthiness standards can be maintained. Capt. Davis (above, center) maintained an efficient turboprop transport must be a new design and not a modification of an existing one*

R. L. Bell: "Can you tell us something about the tests to date?"

Donald Elder: "We have been very much encouraged by the results of the tests. The YT-34 engine has been very reliable and consistent in its performance. During the month of June, for example, we logged over 30 hours, and each flight was of more than 5 hours duration.

"As far as problems are concerned, we know that some improvements need to be made in the propulsion system. Basically, however, it looks as though we have a good combination in the powerplant."

R. W. Rummel: *"While definitive Federal certification regulations for piston-engine aircraft are well established, it is my understanding that such special regulations as may be appropriate for turbine-powered aircraft a e still in the formative stage. While Federal regulations are basically concerned with establishing minimum safety standards, such regulations can have a significant effect on economy of operations. Would you care to comment on this, Mr. Weeks?"*

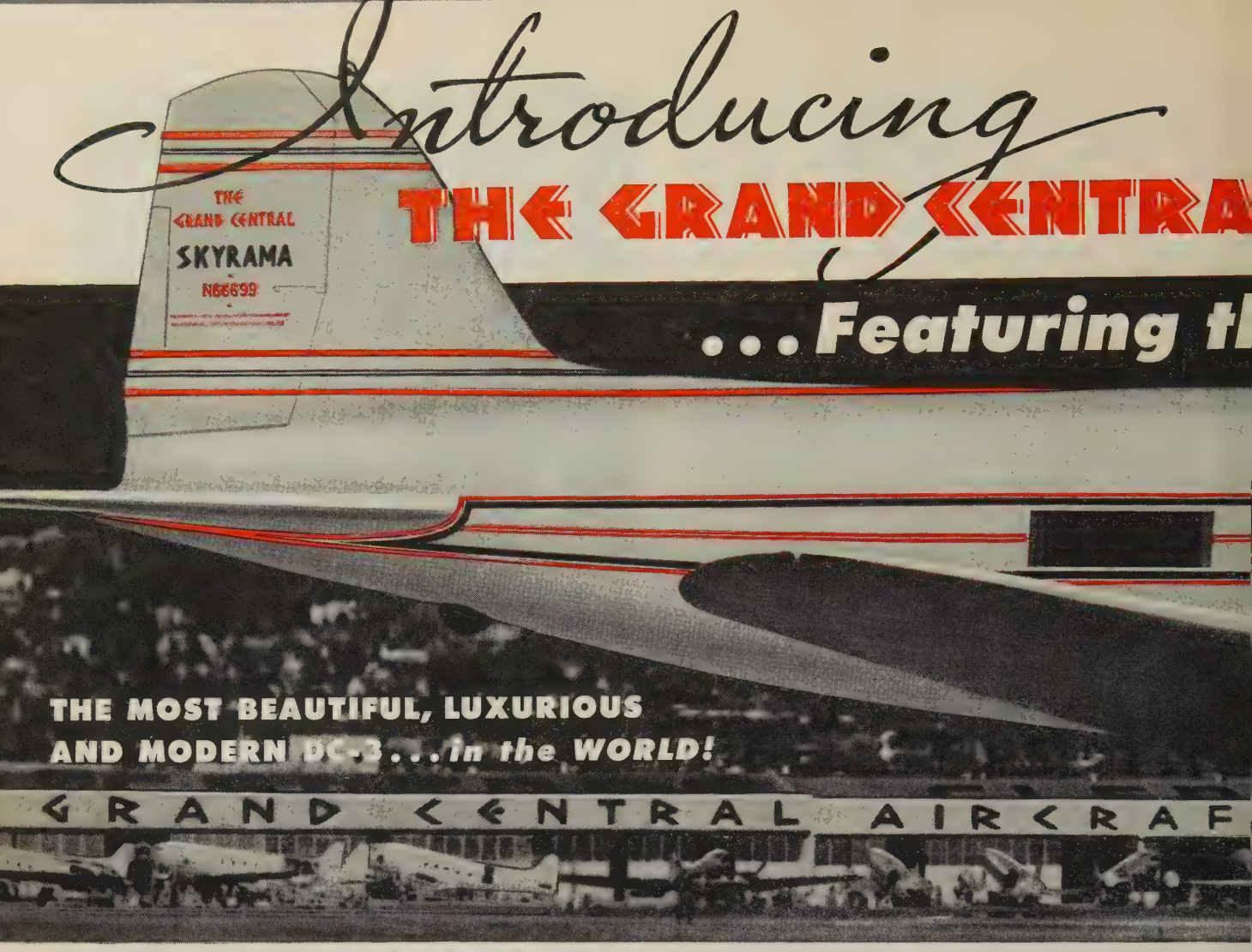
(*Continued on page 22*)

DOUGLAS YC-124B, *turboprop version of Globemaster, is being used to study powerplant performance and all phases of turboprop operation. This experience will go into successor designs*

Introducing

THE GRAND CENTRA

...Featuring t



THE "SKYRAMA".. is an entirely new concept of the executive custom-built airplan deluxe. It combines great beauty and luxurious appointments with careful emphasis on cockpit layout and cre comfort, in addition to extraordinary maintenance features designed to save the owner time and money. Th "SKYRAMA" is super-sound proofed throughout, including the pilot's cabin . . . is scientifically ventilated an equipped with four extra large panoramic windows, affording an unexcelled view in all directions. The Dougl DC-3 is recognized as the world's *most service tested* and *safest* airplane . . . The "SKYRAMA" is the last word the modernization of this great airplane . . . MASTER CRAFTSMANSHIP FROM TIP TO TAIL.

THE "SKYRAMA" IS DIVIDED INTO THREE EXQUISITE SECTIONS

1. The "SKY-ROOM" . . . a carefully engineered and *completely new* re-manufactured nose makes possible *for the first ti* the sensational new "SKY-ROOM," with its deluxe observation compartment for four passengers *directly behind the cockpit* . separated by plexiglass, it *is possible to observe the crew in action* and *have the same broad panoramic view ahead it enjoys* addition to the full view observation through the large passenger windows on each side...NEW—SENSATIONAL—DESIRABL

2. The "SKY-CABIN" ...an ultra quiet secluded compartment, for six passengers, with divans comparable to the finest for sleep or relaxing...four large 17"x17" full view windows...circulating fresh air, indirect fluorescent lighting and radio speaker recepti

3. The "SKY-LOUNGE" . . . restrained modern decor with maximum comfort, convenience and great beauty . . . luxuri appointments for nine passengers that include: executive desk — radio and telephone . . . movable lounge chairs — reclin and swivel . . . window loge with unexcelled view through 17"x56" panoramic windows . . . last word in modern buffet stylin with cabinets and utilities . . . together with wardrobe, luggage and generous storage.

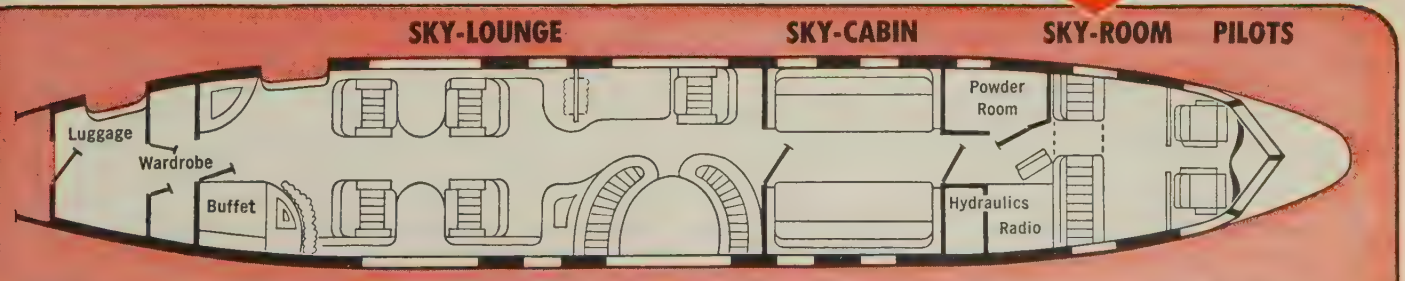
GRAND CENTR

GRAND CENTRAL AIR TERMINAL

SKYRAMA

EW SENSATIONAL "SKY-ROOM"

e "SKYRAMA" is the last word in DC-3 modification. It is designed h the latest and finest improvements to assure safety, speed, comfort, eration and maintenance economies. These new features include: ractable tail wheel — increased fuel capacity — electric steps — npletely re-designed and improved hydraulic system — enlarged ndows — Grimes rotating beacon — special heating and air ventila- n — new gross weight approval — longer range — increased speed Here's a ship that you'll be hearing plenty more about . . . it marks other milestone in the development of executive type aircraft . . . new and outstanding in its appointments that the conventional cutive aircraft has been entirely outmoded . . . *an achievement of unparalleled experience by GRAND CENTRAL AIRCRAFT CO., erica's foremost Company specializing in Aircraft Engineering, dification and Overhaul.*



WRITE or TELEPHONE . . . . W. M. CLOUGH, Vice President — Operations & Sales, for ILLUSTRATED FOLDER or for a DEMONSTRATION — CHapman 5-1222 or Citrus 3-1141

AIRCRAFT CO.

LE (Los Angeles County), CALIFORNIA

Round Table Participants

G. C. YOUNIE, Chief Engineer for Braniff Airways, has an M.E. degree from Texas A&M. Except for period of service with Army Corps of Engineers during World War II, Mr. Younie has been with Braniff since his A&M graduation.

F. E. DAVIS, Chief Engineering Pilot for Eastern Air Lines, was a copilot for TAT; joined Ludington Air Lines in 1930 and became an EAL pilot when Eastern bought Ludington. Mr. Davis was named Chief Engin. Pilot at close of WW II.

DONALD L. ELDER joined Douglas Aircraft following his graduation from University of Michigan (1950) with M.S. degree in aeronautical engineering. He was a Navy pilot from 1942 to 1945 and today is in the Naval Reserve.

LT. COL. JOHN C. LAYSON, Chief, Requirements & Development Div., MATS, studied aeronautical engineering at Purdue, obtained flight training at Randolph and Kelly Fields, and is graduate of AF Institute of Technology.

R. E. GEARY is graduate of RPI. Before becoming Technical Advisor to MATS, he served as Development Engineer for Simmonds Aerocessories, Aerodynamicist for Curtiss-Wright, then Chief of Engineering, Air Transport Command.

DR. C. J. WALKER, Mgr of Preliminary Design for Aircraft Gas Turbine development department of GE, obtained his DME at RPI in 1936. He is a member of ASME, NSPE, AAAS, Sigma Xi, and the Engineering Society of Cincinnati.

T. M. SULLIVAN is West Coast Representative for the Fairchild Engine Division. He previously directed Field and Installation Engineering and was in charge of Flight Test and Operations. Mr. Sullivan has been flying since '37.

W. H. WEEKS is a graduate of University of Missouri and MIT. From 1932 to 1937 he operated a flying school and was employed by airline and aircraft manufacturers. In 1937 he joined CAA; is now Chief, Aircraft Engr. Div.

GEORGE W. BRADY, Director of Engineering, Curtiss-Wright Propeller Div., joined C-W as a stress analysist in 1935, transferred to design engin.-propeller, in 1936. He is a graduate of Yale University (1925) and MIT (1927).

ANTHONY F. DERNBACH is Senior Project Engineer, Hamilton Standard Division of United Aircraft. He formerly was Chief, Aerodynamics Branch, Propeller Lab, Wright Air Development Center. Mr. Dernbach is a member of IAS.

ROBERT L. WELLS who represented Westinghouse Electric is Assistant Chief Engineer of the Westinghouse Aviation Gas Turbine Division. Mr. Wells is a graduate engineer.

M. G. BEARD, formerly Chief Engineer, is now Assistant Vice President- Research & Development, American Airlines. Dan Beard learned to fly at Kelly Field and for some years was Chief Engineering Pilot for AAL. He is member of IAS.

RALPH L. BELL, Director Sales, Boeing Airplane Co. since 1952, joined Boeing in 1946 as sales engineer and was named assistant sales manager in 1950; is graduate of Maryland Institute, did graduate work at Johns Hopkins Univ.

"PURPOSE *of turboprop test-bed projects," said Col. Layson (left), "is to obtain operational experience with that powerplant"*

Wm. H. Weeks (*Chief, Aircraft Engineering Div., CAA*): "The CAA has been in the development stage on this, and we have not as yet approved any turboprop or turbojet aircraft, although we are quite willing to do so. However, I do not believe we should try to finalize extensively or make recommendations to the CAB relative to formal regulations until we have sufficient experience and knowledge to come up with a rational and legitimate type of standard. Therefore, according to our present procedures, when we receive applications for turboprops or turbojets, we handle each project individually and develop standards which will give us the same level of airworthiness that we have with our present-day transports. Actually, we have hopes of even higher levels of airworthiness because of the basic simplicity of the turboprop and turbojet engines."

R. W. Rummel: *"Isn't the problem of continuity of regulations introduced by that particular method?"*

Wm. H. Weeks: "We aren't into the program enough to know as yet. There is considerable variation between each model airplane that has been approved and we never actually approve any model to exactly the same set of standards or perhaps even the same level of airworthiness. There always are differences, so we start from a rather indefinite base and then have to proceed from there. I think we will have difficulty in uniformity with the first two or three models and with subsequent models introducing differences in design features. Because of the increasing complexity of aircraft and the great differences in designs, it is becoming more difficult to maintain a generalized set of standards which will anticipate all the problems of all the design features we will encounter. I think we will have to have more specialized rules for designs of the future than we have in the past."

Dr. C. J. Walker (*Mgr., Preliminary Design, Aviation Gas Turbine Div., General Electric*): "The variations in engine design have a large bearing on this subject since the potential powerplants are piston-type, turboprop-type, turbojet-type and turbofan-type. Since this rather wide variety of powerplants has a rather wide variety of connected problems, and since the engines are not all in the same stage of development and since development of each is going on at a rapid rate, I would suppose that the problems arising from standardization of these would continue for an indefinite period, perhaps 10 to 15 years."

G. C. Younie (*Chief Engr., Braniff Airways*): "Several of us are operating airplanes today that at one time we thought could be converted to turboprop. With reference to the type of airplane that could be certificated quickly, if we could take the same basic airplane, make a few changes in the nacelles and possibly the tail, and install turboprop engines, we'd then have a turboprop transport. If such a thing were to come (*Continued on page* 45)

Performance PITFALLS

from the Files of the Flight Safety Foundation

by Jerome Lederer and Robert Osborn

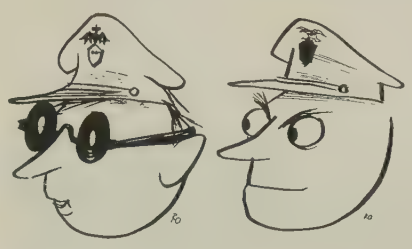
TWO BEERS = 22% LESS EFFICIENCY

Here are some brief excerpts on alcohol from Ross McFarland's book, *"Human Factors in Air Transportation,"* (McGraw-Hill). Several airlines have ordered this book in quantity, and its impartial analysis of the effects of alcohol on physical fitness is one of many safety items.

"If small quantities of alcohol are taken before meals, an increased appetite may result because of irritation of the mucous membranes in the mouth and digestive tract. The amount of hydrochloric acid in the gastric secretions is markedly elevated, accounting for the deleterious effects of alcohol on ulcers.

Psychological Effects of Alcohol: "The effects of alcohol on behavior can be understood best in terms of its influence on the central nervous system, especially the brain. Contrary to popular belief, its action on the nervous tissue is that of a depressant rather than a stimulant. After taking alcohol, a great majority of subjects manifest poorer performance in muscular skill, sensory acuity, memory and other measurable psychological functions.

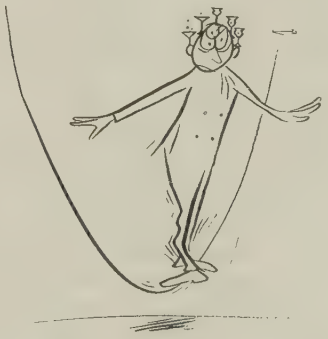
"The impairment of *motor* functions is attributed not to the direct effect of alcohol on the muscles but rather to their nervous control. Muscular reflexes, such as the knee jerk and the protective eyelid reflex, show a decrease in speed and strength after only about 1 oz of alcohol. Movements of the eye while reading or fixating on an object show significant variations in efficiency, averaging 21% of the normal values after 1½ pts of beer or one to two ordinary cocktails.



Sensory Effects: "The influence of alcohol on sensory functions varies considerably from one function to another. The constriction of the visual fields is very pronounced and might impair a pilot in watching for planes in the periphery of his field of view. This phenomenon is clearly demonstrated when an intoxicated driver fails to see a car suddenly appearing from a side street. A pilot's ability to see at night or at low levels of illumination is adversely influenced by alcohol. One study revealed that, after ingestion of 180 cu. cm. of alcohol, there was such an impairment of the sensitivity of the eye that a light had to be twice as bright as it originally was in order to be seen.

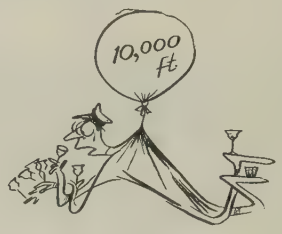
"In one experiment, telegraph operators receiving coded messages were found to be 22% less efficient after two bottles of beer and 56% to 72% after three to four bottles.

"Obviously, a pilot who is under the influence of alcohol would be at great disadvantage in remembering to check his instruments, in making complicated decisions, or in carrying out many other duties while flying modern high-speed aircraft. In aviation, there is not only the influence of alcohol alone to be considered but also the way in which altitude may accentuate these reactions.



Altitude Effects: "If an airman ascends to even a moderate altitude with alcohol in his blood, he would be especially vulnerable to the effects. For example, at altitudes of approximately 10,000 to 12,000 ft the alcohol in two or three cocktails would have the physiological action of four or five drinks.

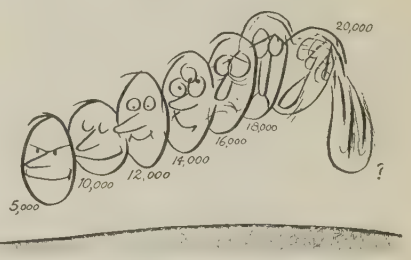
In studies of problem cases among airline flight personnel, excessive drinking was often found to be related to personal or social maladjustment or to apprehension about flying."



Note: A jigger equals 1½ oz or 44.36 cu. cm. Two bottles of beer contain about 1 oz of alcohol.

OXYGEN LACK

Queer things happen when you don't get enough oxygen. In the early stages it's like being a little tight. You become exhilarated, giggly and over-confident; at the same time your judgment becomes unreliable, you become somewhat irresponsible and you may even have hallucinations.



During the war, to impress crews with the necessity of seeing that their pilots had enough oxygen, they were put in a decompression chamber and the oxygen supply reduced. What made it impressive was that all the crew wore oxygen masks except the pilot. As the 'altitude' increased, the effect on the pilot became more and more noticeable. At 5,000 feet the effect was negligible. At 10,000 feet, a mild facetiousness became apparent. At 15,000, if he were playing cards with the crew, odd mistakes crept in. At 20,000, his game became absurd; he couldn't do simple addition and subtraction and his speech slurred. Not long after that he collapsed, unconscious, in the middle of trying to write his name in a scarcely decipherable scrawl. A few moments after his mask was put on and connected to the oxygen supply, he became his normal self.

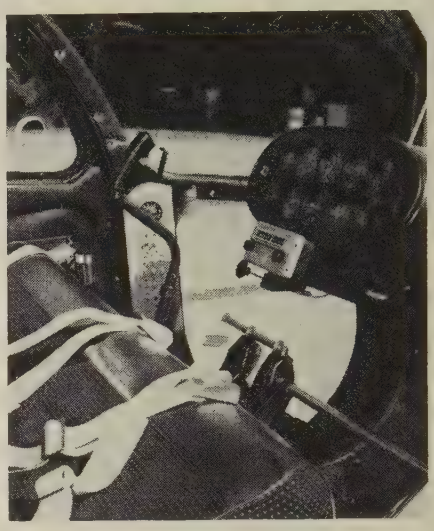
OXYGEN MEDICINE CABINET

When flight personnel are tired after a long trip, it is recommended that they use oxygen a half hour or so prior to landing at their destination. This is especially desirable and helpful on night approaches.

SKYWAYS FOR BUSINESS

NEWS NOTES FOR PILOTS, PLANE OWNERS OPERATING AIRCRAFT IN THE INTEREST OF BUSINESS

BELL MODEL 47H, *designed specifically for passenger and executive market, will be available early in 1955. A three-place copter, it is powered by a 200-hp Franklin engine*



CABIN *of Model 47H is custom designed. Bar is provided as foot-rest for passengers*

Bell Announces New Model 47H Designed for Executive Travel

Fort Worth, Texas. Latest in the well-known Bell Model 47 series of helicopters, the 47H, will be on the market soon after the first of the year. A speedy, streamlined version designed specifically for passenger and exceutive use, the 47H was styled under the personal direction of Bell president Lawrence D. Bell.

It is a comfortable three-place model that is similar in general appearance to the recently announced four-place 47G-1. By streamlining the basic Model 47G, the speed of the 47H has been increased some 20% and a proportionate reduction in fuel consumption has been accomplished. A metal monocoque tail boom contains a baggage compartment large enough to carry luggage for all of the 47H's occupants.

The custom-designed cabin interior has been enlarged 60 inches in width, permitting the use of automobile-size seats for passengers and pilot. Also, the cabin noise-level has been reduced to a point where conversation can be conducted at normal voice ranges.

Boost controls have been incorporated for greater ease of handling, and all electrical switches and carburetor controls have been grouped in a console located at the pilot's left. This permits left-hand operation of the console controls without the necessity of removing the right hand from the cyclic control stick at any time.

Powerplant for the new 47H is an improved version of the 200-hp Franklin engine. Use of removable cowling makes the engine readily accessible. Bell engineers predict a marked reduction in maintenance for the new engine because it will operate at lower percentages of power for equivalent cruise speeds due to the Model 47H's streamlining.

Other innovations include the use of Fibreglas construction for some cabin and door assemblies.

Preliminary flight studies indicate operating costs per seat mile will be considerably lower for the 47H than for comparable craft. As with its predecessor Bell copters, time between major overhaul will be 600 hours.

Although the 47H is intended primarily for executive transport and passenger market, it has been designed to accommodate most utility kit installations and float gear for amphibious operations.

Teterboro Improvements Include Lengthening Runways and Taxiways

New York, N. Y. The Port of New York Authority recently announced the lengthening of the two runways and the taxiway at Teterboro Airport to improve these facilities for business and private aircraft using the New Jersey field.

Instrument runway 6-24 to the southwest-northeast, and north-south runway 1-19 are being extended some 500 feet to the south to provide runways 5,000 feet long. The east-west taxiway 14-32 is being extended 700 feet to the east to provide a length of 3,500 feet. This taxiway improvement will permit all-wind condition operation of the facility as a runway for light aircraft. When the runways are lengthened, 6-24 will be 3,000 feet and 1-19 will be 2,750 feet from the southern boundary of the airport property.

The Port Authority also announced that it is planning to provide a new administration-operations building at the airport which will be convenient to the landing area and which will permit more efficient coordination of operations personnel and equipment. The existing building will be converted to other uses.

These improvements at Teterboro will cost about $500,000, of which $400,000 will go into runway construction, utilities and lighting.

Flight Test of New Petroleum Lubricant Wins an Endorsement

Trenton, Mich. A 50-hour routine flight test conducted by the Michigan Department of Conservation in a light patrol plane has won an endorsement for a new product, GLO Formula 333, a pure petroleum lubricant manufactured by the GLO Corporation in Trenton.

Formula 333 is an homogenized blend of synthetic, colloidal, negatively charged graphite produced from petroleum oil. The graphite is in complete suspension in a pure oil base, thus providing a pure petroleum product composed of both liquid and solid oil. The oil acts as a vehicle to carry graphite to the bearing surfaces where it plates out to form a graphoid film, and this film acts as a mat for the retention of from 4 to 10 microinches more oil than ordinary lubricated surfaces. When bearings are subjected to extreme temperatures or pressures and the liquid lubricating oils are forced from the bearing surfaces, the graphite acts as a standby lubricant and provides lubrication until the oil again flows through the system.

The Michigan Department of Conservation reported, "Cylinder head temperatures ran from 50°F. to 60°F. cooler than previously and the gasoline consumption was decreased from one-half to one gallon per hour."

During this flight test, one-half pint of GLO Formula 333 was used in each 21 gal-

lon wing tank, and one pint in the eight-quart capacity crankcase. Flying was routine with normal take-off, climb and cruise.

AiResearch Aviation Service Adds Radio Shop to Facilities

Los Angeles, Calif. To round out its full capacity to perform complete, all-around maintenance and overhaul of commercial and private aircraft, AiResearch Aviation Service has announced the addition of a radio and electronics department. This new facility is geared to handle aircraft radio sales, engineering, design and installation as well as service and repair of aeronautical communications and navigational equipment. It is CAA-Certified for Class 1 and 2, and later will be certified for Class 3 which covers radar equipment.

Boss of the new function is Harold Jeffrey, former Hughes Aircraft electronics man, and George Lewison is foreman. Mr. Lewison has handled radio activities at AiResearch for several years.

According to Jack O'Brien, AiResearch manager, the new department has one of the most completely equipped radio shops and laboratories in the West, and no expense has been spared to secure the finest of test facilities. Personnel are licensed FCC technicians with considerable experience in aeronautical communications and navigation. A complete stock of radio equipment and parts are carried for immediate delivery. AiResearch Aviation Service is now sales representative for ARC, Bendix, Collins and Wilcox electronic and radio products.

Norman Larson Co. Gears Operation To Serve Business Flyers Exclusively

Van Nuys, Calif. Luxury accommodations await the busy executive who brings his aircraft to The Norman Larson Company at the San Fernando Valley Airport. Designed and built as the nation's most modern air center devoted exclusively to business flying, the new $500,000 facility provides complete one-stop service for the aircraft as well as special conference rooms for executive use. Other features are a pilots' lounge, modern hangars, spacious show rooms for planes and parts, an excellent restaurant and bar as well as facilities for making hotel reservations, etc.

Plane service facilities include radio, propeller and instrument shops.

The Norman Larson Company is Southern California distributor for Beechcraft, Continental, Lycoming and NARCO.

RADIO SHOP *is one of facilities offered at Norman Larson Co. Business Flying Center*

. . . . in the business hangar

The B. F. Goodrich Co. has added a *Lodestar* to its fleet of corporate aircraft. Pilots Hume Earnest and "Tep" Parsons took delivery of the *Lodestar* at Pacific Airmotive where it had undergone an 8,000 hour overhaul, tank seal, and installation of auxiliary fuel tanks, panorama windows and a single-pane windshield. *Lodestar's* interior was done by Aero Interiors and the radio work was done by Qualitron. The plane is now based at Akron. K. R. Sadler is the Goodrich NBAA representative.

A Douglas DC-4 has been added to Leeward Aeronautical's fleet of aircraft available to corporations on a lease basis. Leeward's leasing fleet now adds up to 24 DC-3's and one DC-4.

Oklahoma Pipe Line Construction Company recently traded its Beech D-18 for a Remmert-Werner Super-92 DC-3. Equipment installed in the new -3 includes Collins radio, Grimes rotating beacon, and SAE panel. Company pilot is Gordon Koonce.

C. J. Langenfelder Construction Company's DC-3 has been in the Reading Aviation Service hangar for 100-hour inspection and minor radio work. Capt. C. C. Evering is Langenfelder's chief pilot and NBAA representative.

The B-23 belonging to Food Machinery & Chemical Corp., San Jose, Calif., has a new custom interior as well as a new exterior paint job. Work was done by Mallard Industries at Stratford, Conn. FM&C's chief pilot and NBAA representative is Dick Lane.

Jack W. Miller has joined Northrop Aircraft as an executive pilot. Capt. Miller is an ex-airline and ex-USAF Air Transport Command pilot.

American Can Company has taken delivery of its new Convair 340. In addition to the factory standard communications and navigation equipment, the Convair has a Collins VHF two-way communications system and Glide Slope receiver, dual RMI, and a custom AM-FM cabin entertainment system. All radio work was done by Qualitron. Jim Hopkins is chief pilot and Jim Riley is the NBAA rep.

Ed Armstrong and Jim Smith brought S. W. Richardson's two DC-3's to Executive Aircraft Service at Dallas for general repairs, engine changes and 100-hour inspections. The two -3's were damaged during a recent windstorm in Fort Worth. Ed is chief pilot and his company's NBAA representative.

Russ Holderman, chief pilot for Gannett Newspapers, has his company's *Lodestar* back in the air after installation of a Bendix DME and a TA-18BB transmitter. Installation was done by Page Airways, Inc., at Rochester, N.Y.

The DC-3 owned by Triangle Contracting Co., of Williamsport, Pa., was in the L.B.S. Aircraft shop, Miami, for an engine change.

Bob Aberson, pilot for Gulf Oil Corporation, had his DC-3 at Air Radio Maintenance, La Guardia Field, for installation of a Collins Integrated Flight System. The installation was completed within 24 hours.

Phillips Petroleum Company has had its B-26 at AirResearch for installation of new CB-16 engines with reversible propellers. New fuel cells also were installed and improvements made to the aircraft's interior.

R. H. Fulton Co. has had its *Twin-Bonanza* equipped with a Flite-Tronics CA-1 audio amplifier. The work was done by Aircraftsmen, Inc., at Oklahoma City.

The DC-3 belonging to the R. J. Reynolds Tobacco Company was at Piedmont Aviation, Inc., Winston-Salem, N.C., for a 100-hour inspection. Herb Drew is Reynolds' chief pilot.

The *Lodestar* owned and operated by Papperson, Emerson & Comstock, Pittsburgh electrical construction contractors, recently underwent modification and a general re-doing at Lockheed Aircraft Service-International.

Herb Green brought Gene Autry's *Twin-Beech* to Southwest Airmotive for generator repairs.

Official NBAA Report

NATIONAL BUSINESS AIRCRAFT ASSOCIATION, INC.

(formerly Corporation Aircraft Owners Association)

National Business Aircraft Association, Inc. is a non-profit organization designed to promote the aviation interests of the member firms, to protect those interests from discriminating legislation by Federal, State or Municipal agencies, to enable business aircraft owners to be represented as a united front in all matters where organized action is necessary to bring about improvements in aircraft equipment and service, and to further the cause of safety and economy of operation. NBAA National Headquarters are located at 1701 K Street, N. W. Suite 204, Washington 6, D.C. Phone: National 8-0804.

TACAN Described at RTCA Session

More than 300 top civil and military air navigation and traffic control specialists were on hand in Washington, October 1, as the Radio Technical Commission for Aeronautics opened a full-day symposium on the "Common System of Air Navigation." Before the morning session closed, the U. S. Navy released its first unclassified statement on the controversial TACAN short-range navigation system, and current trends in implementation of the Common System were strongly criticized by representatives of the National Business Aircraft Association, Air Transport Association, Air Line Pilots Association, and Aircraft Owners and Pilots Association.

Col. J. Francis Taylor, Director of the Air Navigation Development Board, as a panel member, read a statement authorized by the Navy describing the heretofore classified TACAN system as an integrated short-range navigation aid less critical to siting, requiring less airborne equipment, and having a lesser accuracy in distance than civil DME but more accuracy in bearing than VOR. Specific data placed the weight of the TACAN airborne equipment at about 85 pounds and size ¾ ATR rack. Over-all bearing accuracy, without benefit of equipment calibration, was stated to be within 5° and distance measuring accuracy within one mile. Under recent ideal test-site conditions with calibrated equipment, accuracies within 0.5° were reportedly attained.

As a panel member, NBAA's views were expressed, *to wit:* At all previous meetings of the Air Coordinating Committee NAV Panel, there has been a tendency by the military departments to introduce tactical requirements into the operational requirements of the Common System. First of all, NBAA does not believe that it is good policy to have any tactical device as part of a public or common system. Tactical devices should all be classified and should be established and operated solely by the military agency requiring them.

The recent requirements for short-range navigation aids established by the NAV Panel included specifications introduced by the military and based solely on tactical requirements. To meet these requirements would impose accuracies in operating conditions far beyond that required for the normal operation of the Common System, and would also impose an implementation and operation burden upon the federal airways system which is unreasonable and impractical. One good example of this is the operational requirements for azimuth and distance devices. The basis for the military requirements was so that interceptors could be automatically vectored to a target, which is purely a tactical requirement.

NBAA further believes that the best possible tactical system and common system should be provided, respectively, for military and civil aviation. It is not good policy to try to mix the two.

NBAA also emphasized that the scope and importance of business flying and its "area" navigation requirements has not been recognized and comprehended by those in government responsible for the promotion and development of civil aviation.

As the afternoon session began, CAA Administrator Fred Lee, also on the panel, said he found the relative accuracy information on TACAN "difficult to accept." He would only comment further that the subject is being studied by the current ANDB VORTAC committee. (NBAA is a member.)

On the progress of Common System implementation and current problems in air navigation and traffic control, the session heard these criticisms from other panel members:

ATA representative, Vernon Weihe, voiced dissatisfaction with present radar coverage, the technical manner in which it is being operated, the method by which VOR is being used and, particularly, with the "Archaic" communication system in use. Weihe urged that parties to the Common System discontinue arguing about trivial things, adding that operation under the principles set down in RTCA Special Committee 31 were sound and should not give way to dependence on the "fickle change" that some agency will come up with something better as the aftermath of war or in preparation for another war.

Speaking for ALPA President C. N. Sayen, W. D. Smith took issue with current operations with two separate navigation systems, inadequate communications, and poor staffing of air traffic control centers. He stressed that personnel staffing problems would continue to exist until CAA changed its system of judging traffic operations to a more offensive one of *how* traffic is being handled, rather than the defensive approach of staffing on the basis of *how much* is being handled.

J. B. "Doc" Hartranft of AOPA called for complete support of the Common System by those represented instead of each becoming so "enthralled in his own problem" that he loses interest in the problems of others. The Common System, he pointed out, is easy to solve by elimination but difficult to solve by inclusion, and by definition the Common System can only mean inclusion.

U.S. Customs Offers Info On Canada-U.S. Flights

The following information was recently released by the U. S. Customs Bureau regarding Canadian Flights:

A) *To Canada:* To expedite flights by avoiding landing in a United States Port of Entry prior to border crossing, the following procedure should be followed if all occupants of the aircraft are U.S. citizens:

Terminate flight plan as below:

"(State number) passengers and one (2) pilots, all United States Citizens, request custom and immigration at (state name of Canadian Airport of Entry)."

This request will usually be granted, and if it is, it should be checked again for confirmation with the last range station prior to crossing the border.

B) *On return from Canada:* Clearance from Canadian authorities is a simple and quick formality. However, only airline passengers can be cleared by United States Immigration authorities. Therefore, on departure from Canada, file flight plan *in person (not by radio)* with ATC, naming United States Port of Entry and stating landing purpose, *i.e.:* requesting United States Customs and Immigration.

In case of aliens, check each individual passenger in ample time prior to flight to acquire necessary additional documents, or postpone flight until needed documents are available.

RTCA Committee Named To Monitor Common System

The first meeting of the newly formed steering committee Radio Technical Commission for Aeronautics to monitor progress of the Common System of air navigation was held October 14. R. L. Froman of CAB was named chairman of the group. Other representation includes: Jean H. DuBuque of NBAA; Vernon Weihe of ATA; J. B. Hartranft, Jr. of AOPA; H. M. Hucke of Radio Electronics Television Manufacturers Assn.; J. H. Tippets of CAA; John Evans of FCC; Col. J. F. Taylor of ANDB; R. O. Smith of USAF; H. I. Rothrock of the Navy, and Dr. W. M. Young of the Army. A report on the findings and recommendations will be carried in a subsequent *NBAA Report.*

Air Traffic Control Committee Meets

Representing NBAA at a meeting of the Boston Air Traffic Control Committee was Vassily De Samsonow, Pilot for Sprague Electric Company of North Adams, Mass. His summary of the meeting follows:

"First, the implementation of new Victor Airways 141, 106, 146, 151, and B58, has already appeared in current Jeppesen Charts. South Weymouth now has GCA available; and the South Boston Fan Marker has been decommissioned.

"All were reminded to check the *Air Guide* for holding pattern speeds. USAF Radar Advisory is available in the Boston area, excluding Connecticut, Rhode Island, New Hampshire, and most of Massachusetts, until interphone facilities are available. Norfolk-Boston Radar is under study and will shortly be activated. In the Albany area, USAF Advisory is available on G-2. Grenier Radar will be available soon. However, ATC is worried about vectoring—just recently an aircraft, after having been safely guided out of a thunderstorm area, found itself 75 miles off course, much to the surprise of both the pilot and the controller when the aircraft was returned to him.

"Air National Guard, Schenectady and Westfield, have been activated to fly intercept missions and practice missions.

"In conclusion, a comment was made on the evaluation of separate identification for business aircraft. Both Boston and New York Center recommend that no such separate identification should be made available to these aircraft, simply because it would lead to more and more flight operations requesting a separate type of identification and expecting recognition of their request, thereby creating too many different classes."

The next meeting of the Boston Air Traffic Control Committee is scheduled for Tuesday, December 7, 1954. *NBAA members desiring to attend should mark their calendars now.*

DME-TACAN Report Found Subject to Further Delay

Asst. Defense Secretary, Donald A. Quarles (Research and Development) has further explained the delayed report of the Special Group studying the controversial DME-TACAN navigation systems. New evaluation work now in process, he said, has not been completed, and estimates it will then require 60-90 days, possibly more, for the final report to be submitted to the VORTAC committee.

Weather Bureau Stations Understaffed, Overworked

At many of its field stations the Weather Bureau has only one person on duty at a time. He must allot his time in such a manner that the work of highest priority is accomplished first. At certain periods during the hour he is engaged in observing and reporting local weather conditions and cannot take time to answer the telephone or to brief pilots. At stations taking pilot balloon observations the observer may be away from the office as much as an hour and thus be unable to supply information to anyone who may call at the station either by telephone or in person.

Pilots visiting Weather Bureau stations and finding the observer occupied in taking an observation should feel at liberty to go through the sequence material on display to find the desired information. In case the pilot is unable to find all the necessary material, he is welcome in the office until the person on duty is free to give him assistance. When observing and reporting local weather conditions, the observer is serving many pilots in the area as well as the weather forecasters and briefers who are responsible for disseminating weather information to thousands of people. For this reason, if there are conflicting duties the observer should perform first that which serves a large number rather than the individual.

In the early days of aviation the Weather Bureau was able in most cases to meet the pilot as he entered the office and, if necessary, spend 10 to 15 minutes briefing him on the weather. The expansion of aviation makes this practice impossible today and pilots should inform themselves of alternate ways of obtaining necessary weather information. They should become familiar with the style used in sequence reports, forecasts, outlooks, etc. Pilots should also become familiar with the *Flight Information Manual* and *SKYWAYS Airport Service Directory* as the means of obtaining the most advantageous telephone numbers to be used in calling the Weather Bureau.

Business Flight Center Opens at San Fernando

NBAA Associate Member, the Norman Larson Co., has its new $200,000 Business Flight Center at San Fernando Valley Airport in operation. Incorporated in the center is all the business and flying know-how compiled by Norman Larson in over 25 years of operation. Mr. Larson is a former president of the National Aviation Trades Association, (NATA).

Getting away from the old idea that a hangar is "just a place to store a bunch of planes." T hangars have been specially designed, incorporating innovations adaptable to the California weather.

Designed for "one-stop" service, mechanical facilities and parts department are patterned after their automotive counterpart. Customer service at the business flying center is complete. Larson extends a cordial invitation to NBAA members to visit the center when in California.

NBAA Vice Chairman Cites Interdependence Of Corporation Aviation and Airlines

NBAA Vice Chairman Henry W. Boggess, Director of Aviation, Sinclair Refining Co., Tulsa, Oklahoma, in his address before the Aero Club of Washington, D.C., September 28, pointed out to the large group of members and guests, that "the airplane is now recognized as a modern tool which all types of business men may use to great advantage."

The airlines and business-airplane operations have been a stimulus to each other, rather than being competitive, he said. The airlines have greatly contributed to the education of the businessman as to the safety and practicability of air travel. "Even with his own airplane," he stated, "the businessman today uses the airlines more than ever before. As one has grown—so has the other. A survey to determine the growth relationship of business airplanes and airline utilization would seem to be a proper project for NBAA and ATA. It would be most interesting and constructive to establish their economic interdependence."

CAA Booklet, "Look and Live," Now Available from Govt

The Civil Aeronautics Administration has published a 17-page booklet entitled "Look and Live," which covers some of the basic fundamentals of safe flying. The booklet covers subjects under the heading of taxiing, turns, stalls, and spins, engine failure, fire, carburetor ice, ground loops, proper loading, filing of flight plans and the four rules of safety.

Copies may be secured by writing the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., and requesting the CAA booklet entitled "Look and Live" with an enclosure of 15 cents per copy.

CAB Publishes Business Flying Accident Analysis

For the first time, the Civil Aeronautics Board has published an accident analysis report on business flying. NBAA as urged the CAB for several years to prepare such a report, and to make a clear distinction between company-owned and operated aircraft flown by full-time professional pilots and those flown partially for business purposes by individuals and organizations. The outstanding safety record of strictly business aircraft operators has been marred in the past by accidents erroneously attributed to professional business pilots.

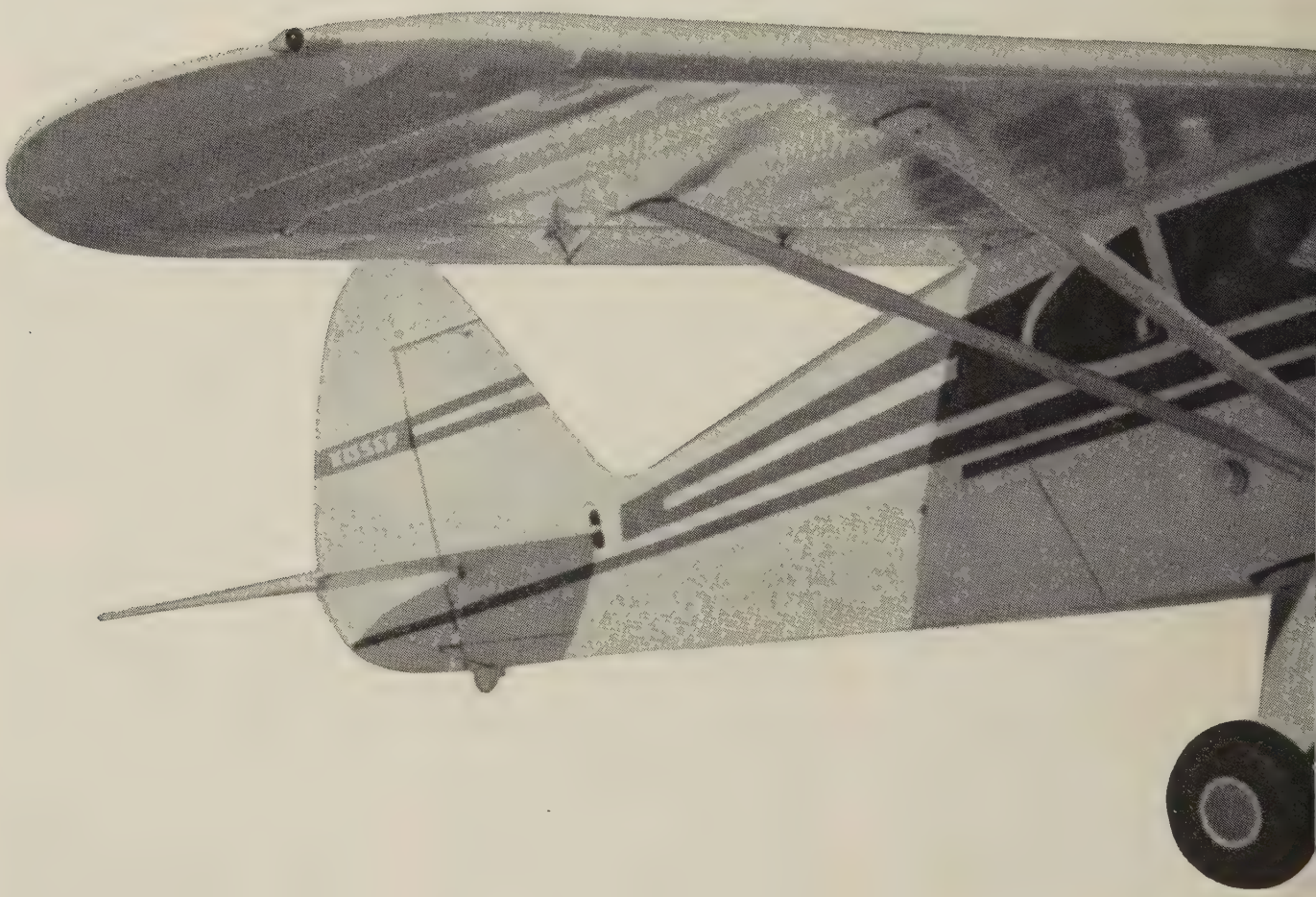
The CAB report covers the years 1950-53 and discloses that company-owned aircraft were involved in 195 accidents during the period. Of the total, 28 were fatal, 10 serious, and 157 resulted in minor or no injury. The four-year breakdown is as follows:

Injury Index	1950	1951	1952	1953	Total
Fatal	7	7	6	8	28
Serious	1	4	4	1	10
Minor/None	26	43	40	48	157
Total	34	54	50	57	195

Although the total number of accidents has increased, the number of individual fatalities has decreased from 49 in 1950 to 18 in 1953. The report states: "It would add value to the report if it were possible to correlate the accident totals to the exposure . . . however, official statistics are not now available for this purpose."

Hourly figures available through the National Business Aircraft Association, private surveys, and the Aircraft Industries Association for 1952-53 show sharp jumps in hourly usage and mileage flown, speaking well for the accident rate. Most recent figures published by AIA indicated that the business fleet flew about 6,450,000 hours in 1953 for a total of about 903 million business plane miles.

MORE POWER...MORE SPEE



Here's the finest Tri-Pacer ever built by Piper—the beautiful new Tri-Pacer 150 for 1955, more powerful version of the most popular low-cost, four-passenger plane on the market today.

Now with 150 horsepower, the Tri-Pacer has more climb, more cruising speed, more payload, more of everything to make this famous airplane the ideal combination of safety, performance, utility and economy—the four features you want *mos* in your airplane.

You also get striking new beauty in the Tri-Pace 150. Its lengthened profile and gleaming pain scheme in Sun Valley Ivory make the new Tri Pacer 150 a stand-out on any flight line. Fly i today at your Piper dealer's.

Just one flight will convince you that the nev

MORE PEOPLE HAVE BOUGHT PIPERS THAN ANY OTH

...MORE PERFORMANCE...

THE NEW 150 TRI-PACER

i-Pacer 150 is another great plane by Piper.

It has all the popular features, proved and im-
oved by millions of hours of hard use, that make
so practical for farm, business and personal fly-
g—tricycle gear for landing ease, interconnected
ntrols for flying ease, separate front and rear
ors, big baggage and cargo capacity, famed
per Duraclad finish for durability and long life,
and quiet, comfortable, spacious cabin.

And now the Lycoming 150 horsepower engine adds superb performance—wonderful short field and high altitude characteristics, over 125 mph cruising speed and unusual economy both in initial investment and operating cost.

See and fly the Tri-Pacer 150 today or send for new full-color brochure.

LANE IN THE WORLD

PIPER
AIRCRAFT CORPORATION
Lock Haven, Pennsylvania

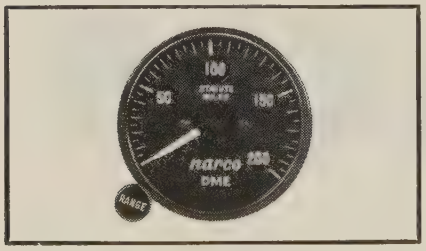
NARCO DME HAILED BY PILOTS

Distance Measuring Equipment Adds New Safety, Efficiency and Flight Ease for VFR and IFR.

Positive, continuous indication of exact position is now an everyday reality for scores of aircraft equipped with the new Narco DME. This Distance Measuring Equipment tells the pilot his exact distance from any VOR/DME or ILS/DME station.

Since the Narco DME was introduced, executive aircraft in all parts of the country have been equipped with this new electronic navigation aid and many more installations are being completed each week. Built to full airline standards, the Narco DME is also undergoing exhaustive airline evaluation with excellent results reported to date for safer and more efficient scheduled operations.

Those who are now using DME report greatly simplified VFR and IFR operations—no more cockpit calculating to estimate position; ground speed or winds aloft easily checked; ETA's on the money; holding patterns "duck-soup", and ILS approaches far simpler.



Two-Scale Reading

The Narco DME was developed under CAA/ANDB sponsorship and is the first of Narco's Sapphire line of equipment designed to the very highest electronic standards possible. It meets full CAA Type Certificate requirements for airline use and has exclusive crystal-tuning feature for positive "locked-on" tuning with no chance of off-frequency transmission or reception.

Mileage is given on the standard size, panel-mounted indicator shown above. By flipping a switch the pilot can select either the 0-200 mile scale or the 0-20 mile scale for precise close-in approach or ground speed check.

The main interrogating unit is remotely installed on a standard ½ ATR rack. Total equipment weighs only 32 pounds.

DME System Nears Completion

DME is the next link in the common-system of navigation agreed upon by the military and civil air space users and now being implemented by CAA.

The vertical pole above the dome-shaped VOR station is the DME antenna, now being installed at all VOR stations throughout the country and at many ILS sites to give the pilot precise information on distance to touchdown. 246 DME stations are already in operation with the entire system to be completed in less than a year, according to CAA.

Nation-wide Narco DME Service

To assure users of perfect operation of their Narco DME, Narco established a complete nation-wide service network and conducted an extensive service school even before the first DME was delivered.

Service centers with complete test equipment are now in operation at conveniently located spots. Thanks to this and the unitized construction which permits quick and simple interchange of basic elements, Narco DME users can be sure of continued, reliable use of their equipment.

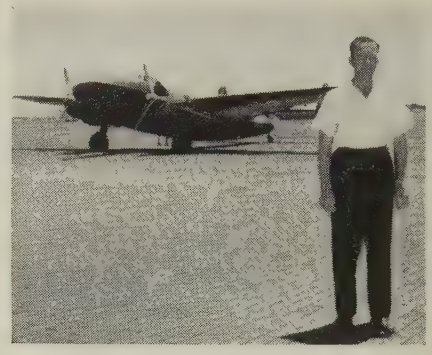
Don't delay putting the DME system to work for you. See your nearest NARCO distributor for further details or write for brochure on the Narco DME to

narco

National Aeronautical Corp.

Ambler • Pennsylvania

Enthusiastic DME Users Report



FRONTIER CHEMICAL CO. Dallas, had Narco DME installed by Associated Radio Co., Love Field.

Chief Pilot Charles Bolton, above reports: "We are extremely impressed with the accuracy of the Narco DME. The readings are within half a mile. I think this equipment will eventually be a 'must' for any airplane especially in congested areas."

—oo—

***KIRSCH COMPANY,** Sturgis, Mich. fly with Narco DME in their Dove, installed by Anderson Radio Co., Detroit City Airport. Max L. Partridge Chief Pilot, reports: "I will say that the use of DME seems to be practically unlimited . . . both IFR and VFR. We have used DME for let-downs . . . that have saved us at least thirty minutes of flying on the several occasions that we have used it." He concludes that DME will help in "a much safer flight operation not only enroute with estimates but for accurate position reports around our major airports."*

—oo—

ALLEN G. STAMM, Aero Commander owner Turbotville, Pa. after extensive experience with Narco DME installed by Reading Aviation Service, Reading Pa. feels this way about DME. "For the type of flying I do in the Aero Commander I class VOR/DME equipment as the Number One nav-aid, with the ADF and auto-pilot second and third. During approximately 200 flight hours since I took delivery of the airplane I have used my Narco DME about 90 per cent of the time, without interruption for service to this unit.

ADC Radar Added to In-Flight Emergency Service

In previous issues of NAVICOM, we have made reference to the availability of the Weather Bureau and the Armed Forces Storm Detection Radar services, in addition to the CAA Air Traffic Control Radar. We have also mentioned the "in-flight" emergency service rendered by both CAA and ADC Radar to aircraft in distress and the emergency attention patterns to be flown to alert the latter services if unable to radio for assistance (also described in Search and Rescue portion of the *Flight Information Manual).*

Inasmuch as all contacts and calls for the above services were to be routed through CAA Traffic Control Centers and/or Communications Stations, little information has been released to the general flying public as to areas in which such latter services would be available.

The Air Force has just authorized and recommended publication of the approximate location of the ADC radars so that they may be added to charts to complete the coverage now offered. It is still recommended that the services of the CAA facilities above be employed to obtain hazardous storm areas data, but in event of genuine in-flight emergency, assistance may be obtained either through CAA or direct on appropriate frequencies.

Again, the obvious caution that abuse of this service will lead to early curtailment.

Approximate locations are listed below by state.

CALIFORNIA
Cambria
Edwards AFB
Klamath
Madera
Mt. Laguna
Point Arena
San Clemente Isle
Sacramento
San Francisco
Santa Rosa Isle

ILLINOIS
Belleville
Peoria

INDIANA
Rockville

IOWA
Waverly

KANSAS
Hutchinson
Olathe

KENTUCKY
Fort Knox

MAINE
Bangor
Brunswick
Limestone

MASSACHUSETTS
North Truro

MICHIGAN
Battle Creek
Empire
Houghton
Port Austin
Sault Ste. Marie
Selfridge

MINNESOTA
Chandler
Finland
Wadena

MISSOURI
Kirksville
Springfield

MONTANA
Cut Bank
Opheim
Havre
Yaak

NEBRASKA
Omaha

NEW JERSEY
Newark
Ocean City

NEW MEXICO
Albuquerque

El Vado
Gallup
Otto
Walker AFB

NEW YORK
Buffalo
Montauk
Saratoga Springs
Watertown

NORTH DAKOTA
Finley
Fortuna
Minot

OHIO
Bellefontaine
Youngstown

OKLAHOMA
Bartlesville
Oklahoma City

OREGON
Condon
North Bend

PENNSYLVANIA
Altoona
Lebanon

SOUTH DAKOTA
Rapid City

TENNESSEE
Knoxville

TEXAS
Dallas
Houston
San Antonio

VERMONT
St. Albans

VIRGINIA
Norfolk
Quantico

WASHINGTON
Astoria
Bellingham
Colville
Larson AFB
Mt. Bonaparte
Neah Bay
Tacoma

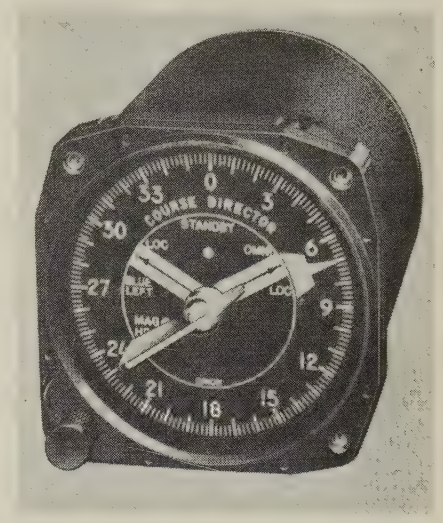
WISCONSIN
Antigo
Elkhorn
Osceola

WEST VIRGINIA
Charleston

New Audio Amplifier Tube Adds to NARCO VHT-2 Performance

The 6BH6 audio amplifier tube (V-108 in both VC-12 Simplexer and VHT-2 Superhomer has been changed to a 6CB6 in current factory production. This tube provides higher gain at low levels as an audio amplifier. In the VHT-2, in speech amplifier operation, a higher modulation level is also obtained.

All sets having this tube type change have addendum sheets inserted in the Instruction Book and the correct tube type stamped upon the side support panel adjacent to the tube socket. For owners and service stations, instructions for making the change are provided in Service Bulletin No. 1049.



ORION *Course Director is a practical, lightweight tracking device; costs under $1,000*

New Course Director Aids Completion of IFR Flights

There have been many occasions in the past when an individual's ability to think out a problem was the major factor in solving operational equations. Proof that this is fast becoming obsolete lies in the aviation industry's increasing tendency to turn to automatic electronic computation in trying to raise the percentage of successfully completed instrument approaches.

Just how much can any flight-operations division of any company pay to raise the flight-completion factor? How much is the pilot's proficiency worth in ability to make mental computations of extreme accuracy under very difficult weather and approach conditions? What should be the dividing line between necessity and luxury in providing the pilot with equipment designed to ease his job and safeguard lives and the aircraft entrusted to him?

Apparently recognizing that there is a wide divergence in the cost justification factor for operators of aircraft varying from the airline-type heavy multi's down to the single-engine high-performance business plane, Orion Industries of Richmond, Va. have introduced their Course Director, and "Slaved" Gyro, each designed to sell for less than $1,000. The combination runs about $1,750.

Using the signal from a conventional runway localizer or omni receiver, the Heading Computer portion of the Course-Director system indicates the optimum course to effectively turn onto and hold the desired

ILS beam or VOR radial. Drift due to crosswind is automatically compensated for so that precise track-centering is easily accomplished. Simple centering of the regular cross-pointer indicator is all that is necessary, and mental computation of correct heading at point of turn-on is eliminated.

Precise heading data is obtained from the Slaved Gyro which is produced as a separate unit and which furnishes stabilized magnetic heading indication to an accuracy of 1°! The weight of the entire system is 10 pounds, as attractive a feature as the price. Power is 14 volts at 3½ amperes; 28 volts at 2 amperes.

The essence of the device lies in the fact that the computer adds *corrected azimuth data* to the localizer or VOR signal on the cross-pointer vertical needle. As the pilot flies to maintain the needle on center, the airplane will *always* follow the *most effective track* to intercept and hold the desired localizer beam or VOR radial. Thus, the needle is still responsive to radio-signal data, but in addition *it responds to any changes of airplane heading* as analyzed by the computer.

Normally, the pilot must mentally compute heading to be flown from all the following factors: magnetic bearing of beam or radial, as shown on his chart, his estimated distance from station or transmitter, crosswind drift expected, and present aircraft heading and position with respect to the desired track. Doing this under "heavy weather" conditions is the hardest test of the pilot's art known today. Add to it any complication such as an engine malfunction, etc., and the result could be disaster.

In flights where a track directly to or from a station is not being flown, magnetic-heading data becomes of increasing importance. The vertical needle, responsive to the compass-controlled azimuth gyro, provides a means of maintaining a precise course, even in severe turbulence, with a minimum of attention from the pilot. The ease with which an accurate magnetic heading can be held greatly facilitates tracking of ADF radials, both for en-route use and for the ADF approach.

The above-mentioned compass-controlled azimuth gyro is constantly being corrected by signals from the compass transmitter remotely located in the rear of the fuselage in an area free of magnetic-deviation influences. The gyro is synchronized prior to take-off; requires no further attention for the remainder of the flight; and is accurate to 1°.

The Course-Director selector (*see cut*) is easily explained. The outer circle resembles the familiar omni selector dial and the small knob at lower left controls the rotating outer pointer, here shown reading 070°. If you wish to fly a VOR track to or from a station of 070°, as indicated, the centrally located switch would be set on OMNI/LOC(alizer) as shown and the regular airplane ILS-VOR cross-pointer vertical needle would be flown for optimum interception and track. If a malfunction occurred in the Orion system or the pilot chose to intercept and hold the desired track without the system's help, he would put the selector switch on STANDBY.

If the pilot was flying or intercepting a runway localizer beam, inbound on the front course, without the necessity for a procedure turn, he would place the switch on OMNI/LOC(alizer) as shown, and turn the outer pointer via the course-selector knob to the heading of the runway, in this case apparently 070°. Again, he would fly to center his ILS needle but the computer would relieve him of the difficult turn-on calculations.

Should either a back-course approach be necessary or flight outbound on the ILS for a procedure turn, the pilot would switch to LOC/BLUE LEFT and again fly to center the needle, with the heading computation taken care of by the Course Director.

For purposes of holding on the ILS, quite commonly used today, the pilot will have more easily acquired the necessary drift information for establishing the heading he should fly for the outbound portion of his race-track holding pattern, and each inbound turn at the far end of the pattern would be equally simple, irrespective of his varying positions at the point of starting the inbound turn.

All in all, Orion has offered at a reasonable price, a very practical, light-weight tracking device.

Air-Aids Spotlight

AUGUSTA, Me. — *NW/SE courses of LFRange swung 10° clockwise. SE course (now 139-319°) lies south of Rockland MHW.*

BISMARCK, N.D.—*ILS Outer Locator now 215 KC.*

BLACKSTONE, Va.—*NE course LFRange (now 272°) makes Green 6 parallel Red 77 for better separation at point of intersecting Amber 7 well south of Chester.*

CHARLOTTE, N.C.—*Tower LF now 269 KC.*

CHINCOTEAGUE, Va.—*N/S courses now 035-215° paralleling Victor One.*

DOUGLAS, Ariz.—*VOR frequency changed to 112.6 mc.*

DULUTH, Minn.—*LFRange now 379 KC.*

JOHNSTOWN, Pa.—*New BVOR on 113.0 mc.*

MANCHESTER, N.H.—*Private MHW operating on 338 KC ("MHT") available on request.*

RICHMOND, Va.—*SE course LFRange swung north to 303°, lies directly over Langley LFR and Patrick Henry Airport easing inbound-outbound congestion in that area.*

SEATTLE, Wash.—*Account discontinuance of Couer d'Alene and Superior, Montana LF-Ranges, and inclusion of Pasco LFRange in area, new Operations Letter and procedures available from Center Chief or Regional Office.*

TOLEDO, O.—*ILS coming fast with LOM on 275 KC ("TO") and LMM on 201 KC ("OL") already installed, serving Runway 7 at new Express Airport.*

WILMINGTON, N. C. — *VAR out, BVOR in on 113.6 mc.*

WINSTON-SALEM, N.C.—*Glide slope now 3°, altitude over LOM 2200 feet, over LMM 1120 feet account new location.*

GODETTE *device is blue left-right switch*

Making Front Courses Out of Back Courses

One of the keynotes of good ILS training and procedure is the ability to orient the pilot's mind in terms of the Blue and Yellow sectors (Right and Left of centerline respectively, front course) rather than in terms of centering the Localizer Course Indicator needle. The former builds a better interpretation of the aircraft position with respect to the runway

approach, whereas the latter technique leads to "needle-chasing" and the wild gyrations which grow ever wilder as the needle gets increasingly sensitive, and this too frequently leads to missed approaches.

However, many pilots develop a degree of skill in needle-centering which suffices for ordinary front-course flying. By rigid self-discipline, they take careful "bites" at the heading being flown which is producing a deviation and do get back to and "tie down" the centerline.

Unfortunately, wind and weather conditions are not tolerant of man's shortcomings and the occasion arises when a back-course ILS approach is needed and available. Then the needle centerer has to engage in a mental struggle at a time when he has little spare room for extra concentration. As you can see, the Blue-Yellow Sector man still has a clear mental picture of his position with respect to the course and alters his heading correspondingly. The action of the needle confirms his decisions.

The "needle-chaser" must remember to disregard his normal habit or procedure, and *turn away from* the needle when it deviates, and in effect drag it back to the center when flying a back-course approach. Since back-course approaches by nature are flown fewer times than the front course, it requires an extra high degree of mental discipline and skill to execute such an approach under difficult conditions. And the practice of reversing one's techniques occasionally can adversely affect the execution of a normal approach under trying circumstances.

It is for this fellow then, that the Godette localizer indicator polarity-reversing device has been contrived. (Old-timers may remember a similar gadget devised to mechanically remind the pilot of the respective positions of the A–N signals of the LF four-course ranges. The gadget was mounted on the panel and actuated manually by the pilot after tuning each range.) The Godette device is an ILS blue left-blue right switch which changes the polarity of the current feeding the localizer meter. The switch (*see cut*) is placed in the *blue right* position for normal ILS approaches and omni flying. When flying a back course ILS approach, the switch is placed in the *blue left* position and the pilot can then correct for deviation by once again turning towards the needle.

Complete kit, including switch, placard and installation instructions, costs $7.50 and can be obtained from the Godette Co., Hangar No. 4, Buffalo Airport, Buffalo, N. Y.

ARC Introduces VOR-ILS Panel Display

Some of the improvements in flight instrumentation are so obvious that pilots tend to assume that design engineers are aware of awkward displays. Hence, it is usually with surprise that we greet developments like the RMI and other data-grouping instruments, forgetting how long we put up with eye-tiring full-panel scanning of scattered displays.

The engineers can probably explain why it has been necessary up to now to look at several different instruments to set up or confirm a VOR navigation track. The fact that the *"TO-FROM"* sensing indicator and the Course Selector are rarely referred to after first setting never justified the extra room they took up on already crowded panels. And during VOR approaches, the happy reassurance of proper track selection and sensing while flying the course needle easily justifies the "ALL-IN-ONE" display offered by Aeronautical Radio Corp. of Boonton, N.J.

In 20 minutes of flight demonstration on practice VOR approaches and enroute flying, it is amazing how simple a change can be so gratifying.

CAA and ANDB to Test Elevated VOR

CAA and ANDB have combined forces to determine whether or not increased efficiency and coverage can be obtained from VOR's by the use of a 200-foot tower.

Not only obvious line-of-sight coverage will be expanded but greater freedom from distracting influences (such as trees, buildings, and other sources of course-deflection) is expected. Before anyone rushes to comment as to where has the CAA been all this time, it should be immediately pointed out that such elevating of the omni's was tried in the early development years but failed. It is hoped that improved techniques of today will show a better result.

The test site will be in a heavily wooded area near Harrellsville, North Carolina. It will sit on a 60-foot flat platform atop a 200-foot tower. This platform is designed to cast a radio shadow on the trees immediately below and out several thousand feet, in an effort to minimize the interference.

If the experiment is successful, the facility will be commissioned and other high-tower VOR's installed where siting or distance coverage is a problem. Just leasing a large enough spot in a desirable location has been as great a problem as the technical difficulties.

Pilot's Dream Come True

The **ARC ISOLATION AMPLIFIER**

Type F-11A CAATC No. 1R4-1 Wt. 8 lbs.

This instrument gives both pilot and co-pilot private, independent use of up to 10 audio input channels from range and communications receivers, ADF's and marker beacon receivers, with intercom and sidetones, as required. Both men may listen simultaneously to different channels of their own selection. Each pilot has his own private speaker and headset. There is no cross-cockpit sound interference between pilots or equipment. Pilots enjoy fatigue relief and more efficient division of radio functions. Immediate delivery, 14 or 28-volt DC models.

Write for full details.

ARC

AIRCRAFT RADIO CORPORATION
Boonton, New Jersey
Dependable Airborne Electronic Equipment Since 1928

A

Collins

PACKAGE FOR THE NEW BEECHCRAFT SUPER 18

an improved model for Beechcraft executive fleets around the wo

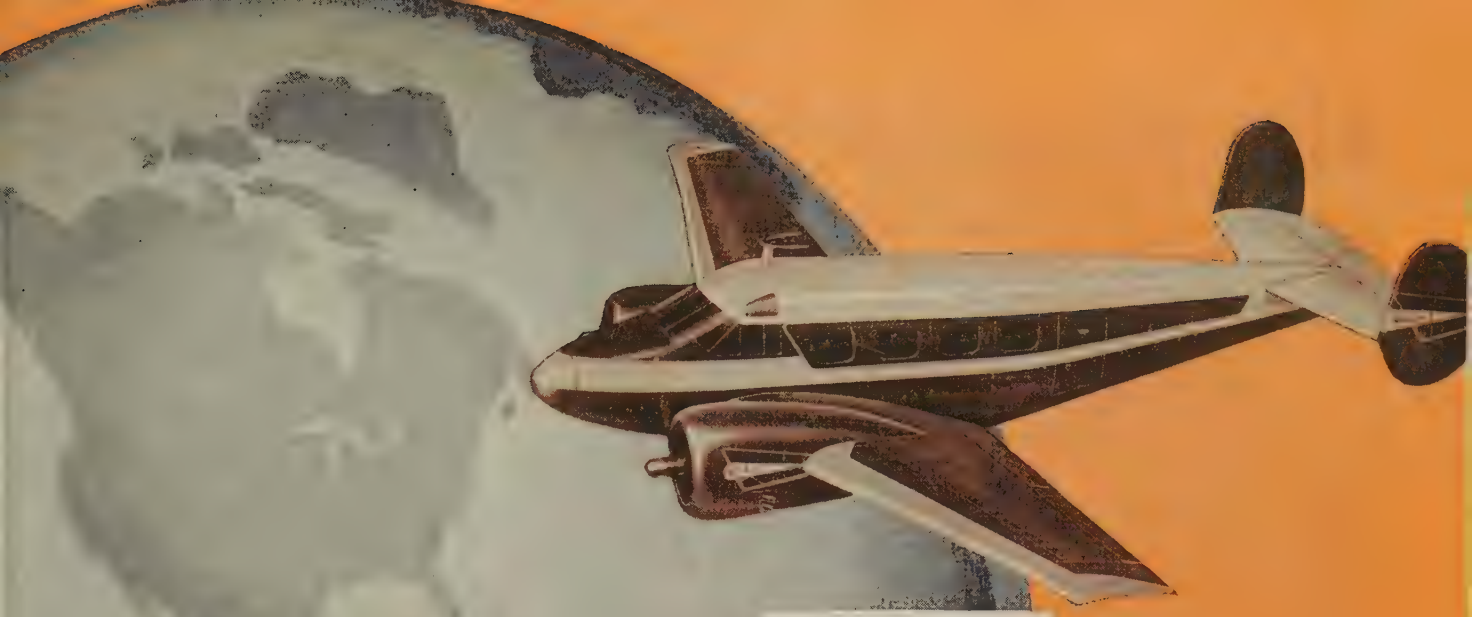
It was 1937 when the first Model 18 Beechcraft started serving American business. Since that time, it has become one of the more popular aircraft in executive fleets around the world — the name Beechcraft has become synonymous with superior, reliable, economical air travel.

But Beechcraft engineers haven't rested on their laurels. They have developed the new Super 18, an advanced airplane with even greater utility and comfort.

Gross weight is increased to 9300 lbs. with over 200 mph cruising speed. The cabin is roomier w more appointments — there are more and lar windows — cockpit area is bigger with more he room for pilots. Because so many Beechcraft own had expressed satisfaction with Collins equipment was decided to offer factory installations. So Coll engineers designed a special Super 18 package stallation for complete VHF communications, d VOR, VAR navigation and precision ILS inst ment approaches. This package consists of: Coll 17L-3 180 Channel VHF transmitter, dual 51I VHF Receivers, and Collins 51V-2 20-chan Glide Slope Receiver. A new radio panel is includ

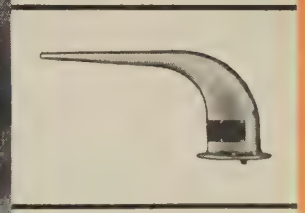
COLLINS RADIO COMPANY

261 Madison Ave., NEW YORK 16 1930 Hi-Line Drive, DALLAS 2 2700 W. Olive Avenue, BURBANK



37-P Glide Slope Antenna
Provides greatly improved sig nal pickup and glide slope re ception in the UHF range.

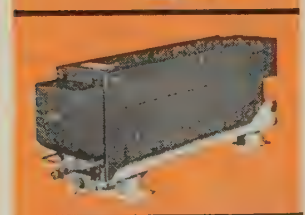
37-J VHF Navigation Antenna
Collins-designed for superior re ception in the 108-122 mc band



37-R VHF Communications Antenna
Used with the Collins 51R — 17L two-way VHF communica tions system.

37X-1 Marker Beacon Antenna
Newest design for light weight ease of mounting and elimina tion of moisture problems.

Collins 17L-3 Airborne VHF Transmitter
½ ATR size, 180 remote con trolled channels.



Collins 51R-3 Airborne Receiver
Provides Omni navigation, LOC instrumentation and VHF com munications. Two units are in cluded in the Super 18 package.

Collins 51V-2 Glide Slope Receiver
Developed in collaboration with leading airline engineers to pro vide a reliable glide slope receiv er to meet ARINC requirements.

provide convenient finger-tip remote control. All HF radio equipment is installed in the nose ction for easy access and elimination of long inter- onnecting cables. And Collins Antennas widely sed throughout the world, are installed as part of ie package.

he installation has been planned so that addi- onal equipment, such as the Collins Integrated light System, may be included or added later as equired.

eechcraft Super 18 and Collins equipment — a inning combination for comfortable, reliable ex- cutive air travel.

COLLINS

EDAR RAPIDS, IOWA

This page for pilots only.

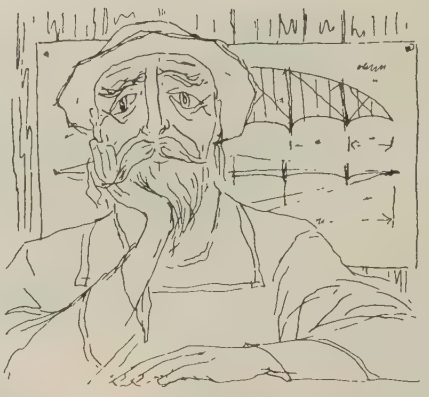
ON THE BUSINESS OF BECOMING UN-AIRBORNE

Some views expressed by various intrepid birdmen through the ages

"THE MOST IMPORTANT PART OF ANY FLIGHT IS THE LANDING"

–Icarus, son of Daedalus.

Daedalus was the "do-it-yourself" type. He fixed up a couple sets of home-made wings out of wax and took son Icky for a short hop. These were Icky's last words as the wax began to melt. There's nothing home-made about the modern pilot's equipment. To ease the strain in the air he has his auto-pilot. To ease the strain of landing he has HYTROL, the Anti-Skid Braking System. HYTROL can be engaged during approach, ensuring positive directional stability immediately on touchdown.



"I'VE GOT IT FIGURED HOW TO *START* FLYING. WHAT BEATS ME IS HOW TO STOP"

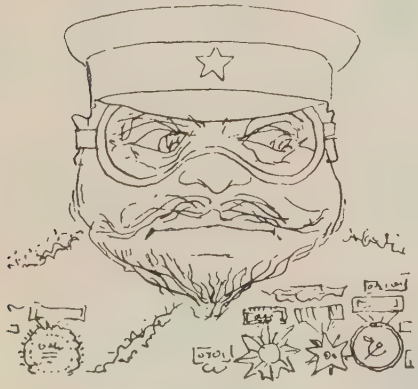
–Leonardo da Vinci

Leonardo was a whizz at figures of all kinds. However, even he would have been impressed by the figures on the stopping power of HYTROL. Required landing run is reduced 33⅓% to 50%. In other words, HYTROL virtually makes short runways longer!

"YOU MEAN AIRPLANE TIRES HAVE TROUBLE WITH FLAT SPOTS TOO?"

–Fifi Phalsephront, female fuselage expert.

Fifi may not be the world's greatest aviatrix, but she knows something about pneumatics. Anyone interested in tire life should know about HYTROL. Because flat spots are eliminated with HYTROL, tire life is both lengthened and made more uniform. Tire changes can be anticipated and held to regular maintenance schedules. Premature blow-outs are prevented with HYTROL.



"ANY LENDINK IS HOT LENDINK—VEN IS ON HICE!

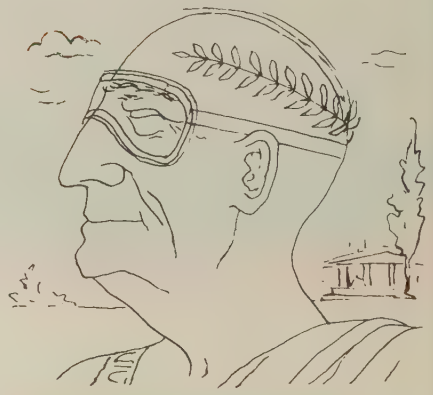
–"Flat-out" Frijinsky, Air Hero of the Soviet Union.

What's so tough about ice, Fridge old boy? In C.A.A. supervised tests on icy runways HYTROL gave straight, controlled stops within 50′ of certificated distances for dry runway conditions.

"ANY LANDING IS A HOT LANDING—PERIOD!"

–Cadet before first jet solo.

The lad should have been told about HYTROL. Not only does HYTROL automatically compensate for speed and weight of plane, type of surface, and condition of tires; it eliminates the human element in braking. The least experienced pilot with HYTROL can make better stops than the veteran without HYTROL.



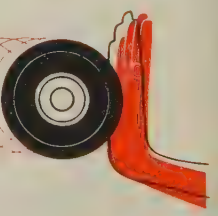
"GREATEST THING SINCE PONTIUS WAS A PILOT"

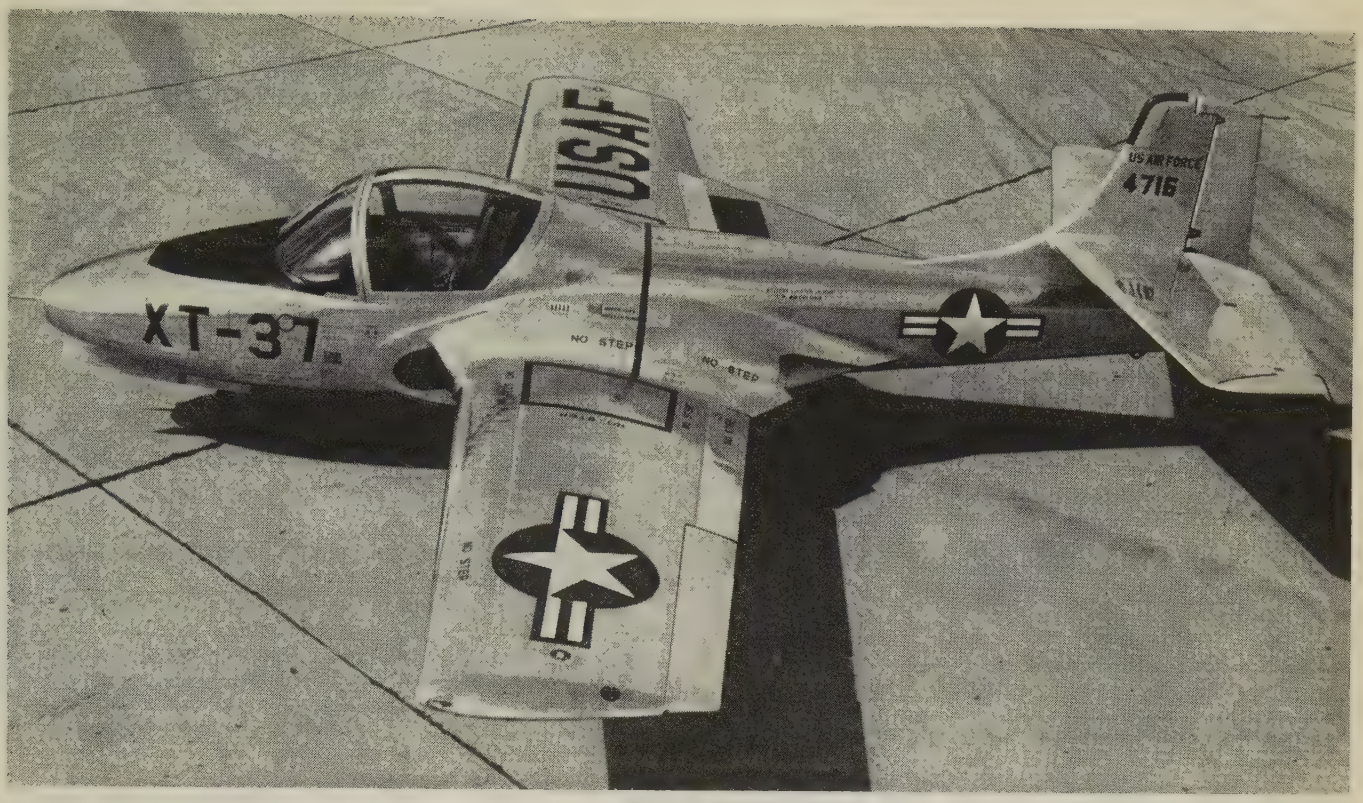
–Any pilot who's tried HYTROL, from Nome to N'Gombo.

HYTROL is light, easy to install, compatible with standard brake systems. May we hear from you?

HYDRO-AIRE Inc.
3000 WINONA AVENUE, BURBANK, CALIF
The Aviation Subsidiary of CRANE Co.

SAFETY PAYS OFF IN DOLLARS...INSTALL *hytrol*





Cessna's XT-37 Makes First Flight

The first jet airplane designed and built by Cessna Aircraft recently made its initial flight and won praises for its performance from test pilot Bob Hagan. Designated the XT-37, this twin-jet is a trainer for the Air Force and is expected to materially increase the safety of pilot transition to high-speed combat-type aircraft.

The XT-37 is an all-metal, two-place, side-by-side, low-wing intermediate trainer incorporating all the latest equipment and design techniques of high-performance jet aircraft. The side-by-side seating was adapted for the first time in a jet trainer in order to increase instructional efficiency. The trainer is equipped with ejection-type seats and jettisonable canopy, electric trim tabs on all surfaces, and hydraulically actuated speed brake. For maximum safety in landing and ground operations, the ship utilizes hydraulically operated high-lift slotted flaps as well as wide tread and steerable nosewheel in the tricycle gear.

Powerplants are Continental J-69 turbojets. Engine inlet screens are incorporated in the forward part of the engine nacelles and are operated in conjunction with the landing gear. When the gear is down, the screens extend automatically over the inlet. When the gear is retracted, the screens retract into the side of the fuselage. These screens prevent stones or debris from entering the engine inlet ducts and causing damage.

To simplify the normal complexities of jet-aircraft operation, the XT-37 is designed for automatic fuel tank transfer during all operations. A set of rubber cell interconnected tanks (six in each wing) feed into the main fuel tank located in the fuselage just aft of the pilot's compartment. Fuel flow to the engines is from this main tank, and engine-driven pumps and submerged booster pumps assure constant fuel pressure for each engine.

The hydraulic system on the XT-37 actuates the flaps, the landing gear, the inlet screens and the speed brake. The wheel brakes are actuated by a separate hydraulic system controlled by the dual rudder and brake pedals. The speed brake is located below the forward portion of the pilot's compartment and, retracted, it lies flush with the contour of the lower part of the fuselage. In use, it will extend to 50°. This brake provides speed and dive angle control throughout the speed range of the trainer.

Cockpit layout, flaps, speed brake, trim tabs and radio controls are positioned and operated the same as those in a high-speed combat-type aircraft, thus simplifying the transition of jet pilots from trainers to high-speed fighters and bombers.

The finished design proposal of the XT-37 was selected from a group of 15 proposals submitted to the Air Research and Development Command in a design competition for a new jet trainer for the Air Force. The design concept of the XT-37 was a challenge to Cessna's design engineers because of high and low speed requirements and weight limitations, and no compromise was permitted on flight characteristics because of the aircraft's mission as a trainer. The fact that Cessna won this competition attests the talents and perserverance of the company's design engineers. Cessna secured the "Phase 1" contract calling for experimental and development work on the trainer in April, 1953. Its first-flight date was decided upon by the USAF Contractors Technical Compliance Board whose members met with Cessna officials to inspect the aircraft prior to flight testing.

Specifications

Wing Span	33 ft	Gross weight	5600 lbs
Length	27 ft	Range	700 miles plus
Height	8.8 ft	Speed	350 mph plus

Convertiplane

(*Continued from page* 10)

tative criteria for the success of such combination products. First, the various combined functions must have a common denominator of utility and, secondly, each of the combined functions must utilize one or more of the major design elements of the product in common. These criteria may be applied to convertiplane types to establish their chances of success.

The utility criterion is met by all types of convertiplanes currently being developed since all use both fixed and rotary-wing functions on each flight. But in the case of common use of design elements for various functions, some variation between types becomes apparent.

In the case of the recently announced XFV-1 and XFY-1 Navy VTO fighters, and the Army-Air Force XV-3 tilting-rotor convertiplane, the principle of utilizing major design elements in both flight regimes is employed effectively. In both, the propellers or rotors are used to provide lift and control in the vertical flight regime, and to provide forward thrust in the horizontal flight regime. Likewise, both types utilize only one propulsion system (a single engine plus mechanical drive to propellers or rotors) for all flight regimes. Therefore, comparative economy in empty weight and cost may be expected with these types. On the other hand, some types of combined aircraft are so designed that the lifting elements for one flight regime are completely useless (or worse than useless) in another. In other types, propulsion system designs are such that a major portion of the system may be unused for one of the flight regimes. Such configurations must be expected to be comparatively uneconomical.

The aim of all types of convertiplanes is to combine preferred advantages in such a manner that the increase in utility outweighs any cost or performance penalties. An unclassified look at the Bell XV-3 provides an indication of just how successful a solution is in the convertiplane.

Operation-wise, the XV-3 is a tilting-rotor type convertiplane being developed under the sponsorship of the U. S. Army with administration and technical supervision of the contract handled by the Air Force.

Rotor-propellers are mounted near the tips of a fixed-wing and operate as conventional lifting rotors during take-offs, landings and low-speed flights. Conversion from rotor to propeller attitude is a smooth, gradual operation which is completed in 10 to 15 seconds. Not only is conversion simple, it can be executed with no loss of altitude and the pilot can stop or reverse the conversion operation at any point. As the rotors are tilted during conversion, the inflow velocity normal to the rotor tip-path plane changes, which requires corresponding changes in blade pitch in order to maintain constant power and airspeed. This may be provided automatically, so that the pilot is required to compensate for minor trim changes during conversion only.

Typical flight procedure is as follows: The pilot takes off as in conventional helicopter flight and is able to perform all the normal maneuvers such as hovering, sideward and rearward flight, pivoting over a spot, and autorotation. In forward flight, he accelerates to helicopter maximum speed, in the neighborhood of 100 mph and, preferably at an altitude of 1,000 feet or more, operates the conversion switch. During conversion, he maintains longitudinal trim by use of the stick; however, conversion trim changes are small, being somewhat less than corresponding changes due to lowering flaps or landing gear in a conventional airplane. After conversion the convertiplane flies as an airplane, and is able to operate at low engine speed for good cruise economy. A gear shift to lower rotor speed may be utilized for additional cruise performance gain.

In returning to helicopter flight, the pilot goes through the reverse of the above process. In case of powerplant failure, there are provisions for making the return conversion power-off, so that emergency landings may be made into restricted areas as a helicopter in autorotation.

Based on our data to date, we are confident that the four-place XV-3 can be operated at 70% of the per-mile cost of operating an equivalent helicopter. Add to this the increased range and speed and you get some idea of the military's and the industry's justifiable optimism.

Larry Bell maintains that the convertiplane's advent will make air transportation available to practically every city in the world, including those whose size makes it impossible for them to support an airport.

When it is considered that the convertiplane not only enjoys a comfortable military and commercial transport market but also is ideally suited for executive transportation, it becomes apparent that the convertiplane is coming and its promise far outweighs its problems. +†+

Figure 2

COMPARISON OF DOWNTOWN TO DOWNTOWN OVER-ALL SPEED AND ELAPSED TIME FOR VARIOUS TRANSPORT AIRCRAFT TYPES

(Extension of Table IV of "Federal Policy Regarding the Development of Commercial Transport Helicopters")

DISTANCE (Miles)	FLIGHT TIME (Minutes)					TOTAL TRIP TIME (Minutes)					DOWNTOWN TO DOWNTOWN AVERAGE OVERALL SPEED (MPH)				
	H	FA	C	PA	JA	H	FA	C	PA	JA	H	FA	C	PA	JA
100	60	35	24	20	11	74	103	40	90	113	81	58	150	67	53
200	120	71	48	40	22	134	139	64	110	124	90	86	188	109	97
300	180	106	72	60	33	194	174	88	130	135	93	103	205	139	133
400	...	141	96	80	44	...	209	112	150	146	...	115	214	160	164
500	...	176	120	100	55	...	244	136	170	157	...	123	220	176	191
600	...	...	144	120	65	...	...	160	190	167	...	...	225	189	216
700	...	...	168	140	76	...	...	184	210	178	...	...	228	200	236
800	...	...	192	160	87	...	...	208	230	189	...	...	231	209	254
900	...	...	216	180	98	...	...	232	250	200	...	...	233	216	270
1000	...	...	240	200	109	...	...	256	270	211	...	...	234	222	284

Summary of Assumptions Used

TRANSPORT AIRCRAFT TYPE	SYMBOL	CRUISE SPEED (MPH)	ALLOWANCE FOR TAXIING, TAKE-OFF CLIMB, LET-DOWN LANDING & TAXIING (Min.)	GROUND TIME TO AND FROM AIRPORT OR HELIPORT & DOWNTOWN (Min).
Helicopter	H	100	4	10
Feeder Airplane	FA	170	8	60
Convertiplane	C	250	6	10
Trunkline Airplane (Piston Engines-Propellers)	PA	300	10	60
Trunkline Airplane (Turbojet Engines)	JA	550	12	90

Total Trip Time = (Flight Time) + (Allowance for taxiing, etc.) + (Ground Time)

Modified for Charter

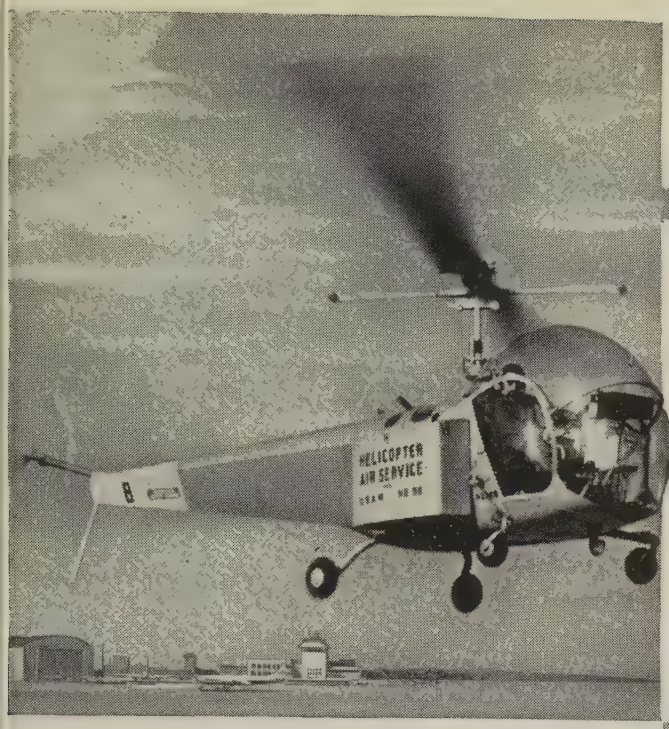
(*Continued from page* 11)

who worked it out and obtained CAA approval—Shop Superintendent George Campbell, and Johnnie K. Hamp, vice president.

"Three electric bilge pumps are connected to a liquidometer," Mr. Hamp explained. "When the water at the lowest point of the hold measures as much as 1½ inches, the pumps start, the equipment turns on a red light on the instrument panel, and a foghorn blows intermittently

"When the plane is moored, the pilot can turn on the emergency master switch and leave his aircraft, secure in the knowledge that not only will the pumps start operating automatically if needed, but the foghorn will also notify anyone within

Big planes are needed for offshore oil exploration in the Gulf of Mexico, Mr. Hamp pointed out, because the water can get too rough for the smaller amphibians used by many oil companies in the waters of Louisiana and Texas. The large personnel-carrying capacity of the PBY permits an oil company to carry complete ex-



Helicopter Air Service, Chicago

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Short hops are tough on helicopter engines

. . . both these operators get outstanding service with

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THE HELICOPTER ENGINES operated by New York Airways and Helicopter Air Service lead a hard life.

Frequent short hops require that the engines alternate between full throttle and idle, and with close schedules they idle a high proportion of the time.

This service calls for an oil that can take real punishment . . . AeroShell Oil.

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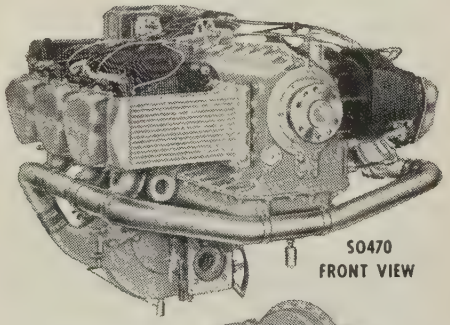
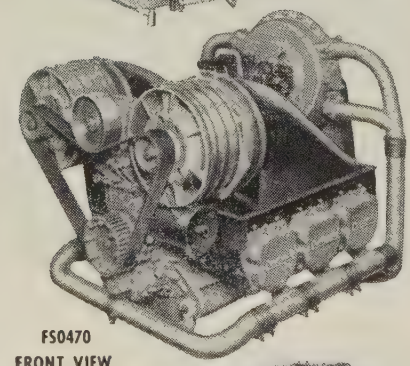
more power... ...better power

. . . TOMORROW'S POWER TODAY

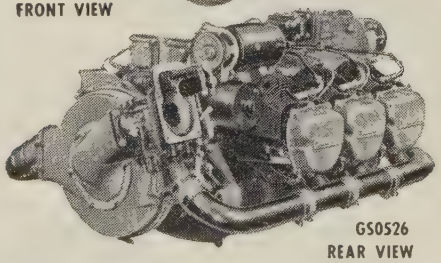
Here are three more reasons why tomorrow's finest aircraft, like today's, will fly with Continental power. Two of them represent further developments of the famous 0470 series —one supercharged, the other supercharged and fan-cooled expressly for helicopter use—while the third is a brand new power plant, engineered and built with the needs of multi-engine utility planes in mind. They have one thing in common: as products of the pioneer in power for utility aircraft, all three rate high in those qualities which go to make up dependability—qualities which have made Continental engines fliers' undisputed first choice.



S0470
FRONT VIEW



FS0470
FRONT VIEW



GS0526
REAR VIEW

GENERAL SPECIFICATIONS

	S0470	FS0470	GS0526
Horsepower	250	260	290
R.P.M.	2600	3000	3000
Alt. (ft.)	10,000	10,000	15,000
T.O. Power (Sea Level)	265	260	320
Length (in.)	37.73	39.64	52.28
Height (in.)	30.77	34.81	23.96
Width (in.)	33.62	33.62	34.68
Bore (in.)	5.00	5.00	5.125
Stroke (in.)	4.00	4.00	4.25
Displ. (cu. in.)	471	471	526
Comp. Ratio	6.0:1	6.0:1	6.0:1
Total Dry Wt. with Accessories (lbs.)	512	550	578
Type of Prop. Drive	Direct	Direct	Geared .688:1
Recom. Fuel Octane	91/96	91/96	91/96
Supercharger Ratio	12.45:1	10.13:1	12.0:1
Supercharger Drive	Belt	Belt	Gear

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Continental Motors Corporation
Aircraft Engine Division
MUSKEGON, MICHIGAN

Modified for Charter

(*Continued from page* 38)

ploration parties, even if part of the plane's capacity is used for equipment; or the plane can handle personnel and equipment for drilling programs or any other phase of oil-industry operations.

The flight engineer's compartment has been converted into a commissary, complete with refrigerator (28-volt) and a hot plate. Functions of the flight engineer may be performed by either pilot or copilot.

Mr. Campbell reported 12,000 man-hours went into the modification work. The Houston-modified PBY carries 21 passengers, compared with 17 and 20 respectively for the two privately owned PBY's. The forward compartment divan opens into a bed.

Total gross weight is set at 28,000 pounds. The airplane carries the usual PBY load of 1800 gallons of gas and 130 gallons of oil, sufficient for 20 hours of flight at a normal 90-gallon-per-hour gas consumption. Two P & W 1830-92 engines, rated at 1250 hp at take-off boost, power the plane.

Mr. Campbell reported the plane cruises at 155 mph, with 17 passengers and 1800 gallons of gas, a typical load. At the same time, power settings are only 1900 rpm and 27″ manifold pressure, a little under normal settings. Pilot is W. R. King, Jr.

Thar She Blows!

(*Continued from page* 17)

push it back at speeds of 40 mph or more.

The other pilots were helpless. There was no other place for the two waiting airliners to go. You see, when the first passenger station and platform was built at Chicago, it was already too small. That is the rule in building passenger stations. So when the City of Chicago built the new passenger station, it was too small also. Therefore, fingers were built out from the station building, and the airliners park alongside the fingers.

There is a rule also about designing runways and taxiways. There must be no place for the airplanes to run up their engines. Putting the fingers out onto the field space was necessary, but a necessary result of not thinking ahead. Actually, so little taxi room is left that when planes are waiting to take off southwest, arriving planes cannot pull into their places on the near finger.

Somehow the propeller blasts of the two airliners went down the runway that I was landing on. It could easily have wrecked us. It can easily wreck you. If you have an executive or private plane and you have only 70 mph airspeed and you suddenly lose 30 mph or 40 mph, you know where you are!

The biggest safety measure we can take is to be fully aware of the danger of the propeller wash. Waiting airplanes should tail *away* from the live runway if they can do so. Allowance should be made for the fact that a slight crosswind can drift a prop wash across a runway even if the waiting plane is not tailed toward it. Engines should not be run up as another plane is landing if it is possible for the prop wash to get to him. It is said that the wash flares out quite a bit, fan-wise.

If you are about to land, take a look to see if a prop wash can get you. You don't want your bottom to drop out.

Pod Mounting Along the Wing	Buried in the Fuselage	Buried in the Wing
E. *Rate of Roll*— With high lateral product of inertia a *lesser* rate of roll will be provided by equivalent lateral control devices. At the same time external upsetting influences, to be effective, will have to be larger.	With a lower lateral product of inertia a *higher* rate of roll will be provided by equivalent lateral control devices. At the same time effective external upsetting forces will be lower than in the pod installation. Lateral stability, therefore, may be a problem.	Position of the powerplant will determine rate of roll. For engines mounted in the wing roots, rate of roll will approach that of the aircraft with fuselage-mounted engines. For engines mounted further out on the wing, rate of roll will approach that of the aircraft with pod-mounted engines.
F. *Asymmetric Thrust*— Installation may require larger vertical tail to maintain aerodynamic directional control under asymmetrical thrust conditions. (Engine inoperative.)	Centralized thrust, regardless of engine failure, is provided. This may permit a smaller vertical tail.	With engines located at the wing roots, asymmetric thrust would be small in the case of an engine failure. This will permit a smaller vertical tail.
G. *Induction & Exhaust System Losses*— Minimum losses in the induction and exhaust systems will provide maximum thrust potential for a specific engine at minimum specific fuel consumption for any power level.	Losses in the induction and exhaust system will cause a reduction in thrust potential for a specific engine with resultant increase in specific fuel consumption and loss in airplane critical altitude.	Losses in the induction and exhaust system will cause a reduction in thrust potential for a specific engine with resultant increase in specific fuel consumption and loss in airplane critical altitude.
H. *Icing Susceptibility*— 1. Engines will be exposed only to free moisture and vapor in the atmosphere. 2. Pod design probably will not permit ready installation of alternate combustion air source.	Engines may have a greater susceptibility to icing if located to scoop up run-back of water condensed on the wing and/or fuselage, as well as free moisture. Installation will permit more ready design of alternate air source.	Engines will be exposed only to free moisture and vapor in the atmosphere. Design of alternate air source should be relatively simple in this installation.
I. *Reverse Thrust Potential*— The pod installation will permit the use of reverse thrust by deflection or other means on all engines. However, asymmetric reverse thrust may create ground-control problems.	This installation will permit the use of reverse thrust by deflection on all engines, but will be a more complex installation. There should be no problem of ground control due to asymmetric reverse thrust.	This installation will permit the use of reverse thrust by deflection on all engines. However, it will be complex. There should be no problem of ground control due to asymmetric reverse thrust in installations where engines are mounted in the wing roots.
J. *Loss of Pod in Flight*— Certain types of engine failures may lead to loss of pod in flight, notwithstanding the fact that pods should be specifically designed to retain the engine even if stopped suddenly. This may create control problems.	Separation of engine from aircraft is highly unlikely.	Separation of engine from aircraft is highly unlikely.
K. *Effect of Airplane Attitude on Engine Operation*— It is unlikely that aircraft attitude will have any appreciable effect on engine operation.	Possible blanking of airflow by the fuselage in certain flight attitudes may affect engine operation (compressor stall). This depends on detail of installation design.	Possible blanking of airflow by the fuselage, especially in yawed flight, may affect engine operation, depending on detail design; however, the degree of difficulty encountered should not be serious.
L. *Effect of Engine Installation on Ground Clearances During Take-off and Landing*— Tolerable angle of roll during take-off or landing will probably not be limited by pod clearances but rather by wing-flap clearances.	Engine installation should have no effect on tolerable angle of roll during take-off or landing.	Engine installation should have no effect on tolerable angle of roll during take-off or landing.
M. *Induction and Exhaust System Losses*— The pod-mounted engine will have a minimum of ducting for intake and exhaust. Therefore, *negligible* intake and exhaust losses will be inherent in this type of installation.	Long runs of intake and/or exhaust ducting will be required. This will make a more complex installation. Induction system and exhaust system losses will be inherent and will have an appreciable effect on engine performance.	Same as "Buried in the Fuselage."
N. *Wing-Flap Installation*— This type of engine mounting probably will not permit the use of uninterrupted wing flaps.	Engine location permits the use of uninterrupted flaps.	Uninterrupted flaps are possible but any flap design will be complex due to requirements for circumventing the engine exhausts.
III. SERVICE AND MAINTENANCE		
A. *Accessibility for Powerplant Replacement*— The excellent accessibility to all sections of a pod-mounted engine is inherent in the design. Engine replacement could be very simple, requiring short out-of-service time.	Congestion in the fuselage area may make engine changes somewhat more difficult than in the pod-mounted installation.	Engine removal would probably require the prior removal of stressed access doors. The actual removal of the engine will likely require greater effort due to lack of accessibility in the engine compartment.

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Design Analysis: Jet Engine Location

(*Continued from page* 16)

C. PROTECTION AGAINST TURBINE-WHEEL FAILURES

Pod Mounting Along the Wing	Buried in the Fuselage	Buried in the Wing
1. If engine turbine wheels lie in a plane which intersects the wing structure, turbine-wheel burst could cause severe structural damage. In most designs the included angle for damage potential in the plane of rotation is slightly less than 90°. The fuel-tank area will be especially vulnerable. The fuselage is also vulnerable but the included angle for damage in this instance is quite small.	The engine turbine wheels will most likely be in a plane which intersects only the fuselage. The included angle for damage potential will be at least 180° with engines buried inside the fuselage. A turbine-wheel burst could conceivably destroy the fuselage structure, including the tail-surface controls, or could destroy adjacent engines.	The engine turbine wheels will be in a plane which includes the wing and fuselage structure as well as adjacent engines. The included angle for damage potential in the plane of rotation is approximately 180°. A turbine-wheel burst in this installation has greater primary structural damage potential than in either of the other installations.

D. SUSCEPTIBILITY TO DAMAGE AFTER WHEELS-UP LANDING OR DITCHING

1. In the event of a wheels-up landing, pods present a design problem requiring the wing structure to be sufficiently strong to prevent damage to the fuel tanks or, alternately, the design must be such that the pods will shear off clean without damaging basic wing structure. In the latter approach, particular attention must be accorded shut-off flammable-fluid flow and electric current flow in several lines.	In the event of a wheels-up landing, it is unlikely that the engines will be torn from the aircraft. However, if the mass of the engines were well aft, the forward occupied area would have to absorb more of the kinetic energy than would aircraft with other types of engine mounts. This may require additional "beefing up" of the forward fuselage area. In addition, mounting structure must be adequate to retain engines, or passenger cabin may be wiped out by engines in what could otherwise be a survivable accident.	Damage incurred during wheels-up landing probably will be in the order of that experienced by a present-day piston-engine aircraft.
2. Ditching characteristics may be questionable unless pods are designed to shear off at time of impact with water.	Aircraft probably will have reasonably good ditching characteristics if closure doors are provided at engine air intakes, or if intakes are located well above the water line.	Aircraft probably will have acceptable ditching characteristics.

E. SUSCEPTIBILITY TO ENTRANCE OF FOREIGN MATERIAL

1. Pods place engines low with respect to the ground, making them vulnerable to airport debris. Particles thrown out by the nose wheel may particularly affect inboard engines unless special deflectors are used in the nose wheel.	Depending on location in the fuselage, the engines may be vulnerable to airport debris thrown out by the main gear as well as by the nose gear.	This type of installation is probably least vulnerable to airport debris. The engine air entrance is higher than in the pod-mounted installation. Engines may be vulnerable to debris thrown out by the nosewheel unless special deflectors are used on the nosewheel.
2. The low position of the engines may make them handy repositories for mechanics' tools. Unless special measures are taken, such "misplaced" tools can become the source of engine failures.	Same as "Pod Mounting."	Same as "Pod Mounting."

II. AERODYNAMIC & PERFORMANCE CONSIDERATIONS

A. *Effect on Aircraft Drag*— Total flat-plate drag of the airplane will be higher due to increased drag created by the pod and pylon.	Total flat-plate drag of the airplane will be lower with the fuselage-mounted engines.	Total flat-plate drag of the airplane will be lower with the truly submerged engine.
B. *Effect on Wing Design*— Pods permit the use of wings of minimum thickness and of lower drag potential. However, wing thickness may be dictated by fuel requirements.	Fuselage-mounted engines permit the use of wings of minimum thickness and of lower drag potential. However, wing thickness may be dictated by fuel requirements.	In order that engines be truly submerged in the wing, a thicker wing will be required. Thus, a wing of higher drag potential or a delta or cusped-wing configuration will be required.
C. *Compressibility Effects*— Careful design will be required to assure that pod interference and compressibility effects are negligible at moderate to high lift coefficients at high speeds.	No specific problem.	No specific problem.
D. *Aerodynamic Fences*— The pod supports will provide aerodynamic fences which may provide improved low speed and stall characteristics.	Engine installation will not provide aerodynamic fences. Low-speed handling characteristics may not be inherently as good as the aircraft with pod-mounted engines and may require addition of fences or slats.	Engine installation will not provide aerodynamic fences. Low-speed handling characteristics may not be inherently as good as the aircraft with pod-mounted engines and may require addition of fences or slats.

Pod Mounting Along the Wing	Buried in the Fuselage	Buried in the Wing
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I. *Reverse Thrust Potential*— The pod installation will permit the use of reverse thrust by deflection or other means on all engines. However, asymmetric reverse thrust may create ground-control problems.	This installation will permit the use of reverse thrust by deflection on all engines, but will be a more complex installation. There should be no problem of ground control due to asymmetric reverse thrust.	This installation will permit the use of reverse thrust by deflection on all engines. However, it will be complex. There should be no problem of ground control due to asymmetric reverse thrust in installations where engines are mounted in the wing roots.
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M. *Induction and Exhaust System Losses*— The pod-mounted engine will have a minimum of ducting for intake and exhaust. Therefore, *negligible* intake and exhaust losses will be inherent in this type of installation.	Long runs of intake and/or exhaust ducting will be required. This will make a more complex installation. Induction system and exhaust system losses will be inherent and will have an appreciable effect on engine performance.	Same as "Buried in the Fuselage."
N. *Wing-Flap Installation*— This type of engine mounting probably will not permit the use of uninterrupted wing flaps.	Engine location permits the use of uninterrupted flaps.	Uninterrupted flaps are possible but any flap design will be complex due to requirements for circumventing the engine exhausts.
III. SERVICE AND MAINTENANCE		
A. *Accessibility for Powerplant Replacement*— The excellent accessibility to all sections of a pod-mounted engine is inherent in the design. Engine replacement could be very simple, requiring short out-of-service time.	Congestion in the fuselage area may make engine changes somewhat more difficult than in the pod-mounted installation.	Engine removal would probably require the prior removal of stressed access doors. The actual removal of the engine will likely require greater effort due to lack of accessibility in the engine compartment.

(*Continued on page* 44)

Design Analysis: Jet Engine Location

(*Continued from page 43*)

Pod Mounting Along the Wing	Buried in the Fuselage	Buried in the Wing
B. *Wing Structure Maintenance*— Continuous wing structure should provide for minimum of maintenance with possible exception of pod attach points.	Continuous wing structure should provide for minimum of maintenance.	Discontinuous wing structure will require special treatment to avoid localized stresses which might increase the tendencies to fatigue.
C. *Accessory Replacement and System Maintenance*—		
1. Practically all powerplant components and accessories will be readily accessible after removal of cowling. Residual heat from the engine will be dissipated more readily due to the fact that the engine can be exposed to ambient air temperatures.	Unless engines are specifically designed for the installation, many accessories and other components will be difficult to reach due to the limited space in engine compartments. Residual heat in the engine compartment after shutdown may further increase the time required for component replacement.	Same as "Buried in the Fuselage."
2. Long and complex control runs may create maintenance problems.	Control runs may be long, but they should be relatively simple.	If engines are mounted inboard, control runs should not be long nor complex.
3. Access to components should permit swift and ready replacement in a period of time less than that required to change an engine.	If components take longer to change than do engines, either engines will be changed (increasing spare engine requirements) or else a penalty paid in greater out-of-service time.	See "Buried in the Fuselage."
IV. STRUCTURAL CONSIDERATIONS		
A. Permits utilization of continuous unbroken wing primary structure.	Permits utilization of continuous unbroken wing primary structure.	Requires highly stressed discontinuous wing structure surrounding the engines with the additional requirement for stressed access doors.
B. For equivalent wing structure, the maximum positive wing bending moment will be less. Maximum negative bending moments would be somewhat larger than in aircraft wings without pods.	For equivalent wing structure, the maximum positive bending moment will be higher than the wing with pod-mounted or buried engines.	Better than fuselage and approaching pod, depending on location of engines.
C. Pods acting as dampeners may permit lighter wing structure or higher design flutter speeds.	Wing will be structurally heavier for a comparable aspect ratio, planform and airplane gross weight.	Complexity of wing structure militates against obtaining lightweight, rigid wing structure.
D. The design problems associated with fuel-tank integrity will be greater due to complexity of engine supporting structure. It is most likely that "dry bay" areas will be required adjacent to pod support structure.	Fuel-tank design should be simplified since the engines are not located in the wings.	Engines will occupy a portion of the wing making this section unavailable for fuel storage.
E. The design problems associated with structural integrity of the pod support during wheels-up landings or sudden engine stoppage will be greater than with other types of installations.	Mountings will have to be designed to retain the engines in the event of wheels-up landings or sudden engine stoppage.	Mountings will have to be designed to retain the engine in place in the event of sudden stoppage. Wing carry-through structure will have to be sufficiently strong to prevent damage to wing.
F. *Effect of Heat and Corrosion on Structural Integrity*—		
1. It should be a simple matter to isolate the engine thermally from the wing structure.	Engine compartment heat will be high, requiring considerable insulation of adjacent areas of the fuselage. This may mean added weight.	Engine will require extensive thermal isolation from the wing structure.
2. Corrosion problems will be restricted to the pod itself and possibly to those parts susceptible to contamination by air circulation, such as wing flaps.	Special design consideration will probably be required to assure that the jet efflux will have no corrosive effective on the fuselage structure.	With proper design, there should be no specific problem of corrosion.
V. INSTALLATION CONSIDERATIONS		
A. Systems which obtain energy from the main powerplants will probably be complicated. (Air conditioning, electrical, pneumatic, thermal anti-icing, hydraulic, etc.)	Compartmentation and segregation of systems may be possible. Simplification of systems is possible.	Complexity of systems would be comparable to that of present-day aircraft.
B. Fuel cross-feed system would be as complex as in present-day aircraft.	Fuel cross-feed system would be simple.	Complexity of systems would be comparable to that of present-day aircraft.
C. If water injection is used, the system will be complex.	If water injection is used, the system could be simple.	Complexity of systems would be comparable to that of present-day aircraft.
D. Extensive ducting systems will be required for cabin pressurization.	If engine air is bled for pressurization of cabin, the ducting would be simple.	Ducting for cabin pressurization system should be reasonably simple.

	Pod Mounting Along the Wing	Buried in the Fuselage	Buried in the Wing
E.	No congestion problem should exist for equipment since components are widely spread at the powerplant locations.	Equipment is centralized in the fuselage and may result in a possible noise and congestion problem.	Equipment congestion will be comparable to that on present-day aircraft.
F.	If engine bleed air is used, anti-icing and de-icing systems may be simple except for fuselage cross-over duct.	If engine bleed air is used, wing anti-icing and de-icing systems will require extensive ducting system.	See "Pod Mounting."
	VI. PASSENGER COMFORT		
A.	*Cabin Noise Levels*— Pod-mounted engines may create a high noise level in the fuselage due to jet efflux unless careful design is provided. In order to keep cabins reasonably free of noise from jet efflux, the rearmost bulkhead of the occupied area must lie forward of the cone of maximum noise. Since the pods are mounted forward of the wing, it is possible that the wing, if mounted low on the fuselage, may provide a sound barrier.	The rearward location of tailpipes should provide for a materially lessened noise level in the occupied area due to jet efflux. Compressor noise, however, will likely be much worse than with pod-mounted engines.	Depending on wing design and engine location, buried engine installations will provide noise problems similar to those pod-mounted installations with the exception that: 1. The wing may not act as a noise barrier. 2. The engines will probably be located inboard on the wing making the problem more acute.
B.	*Effect of Vibration on Passenger Comfort*— With engines mounted in pods well out on the wing, there will be little likelihood of annoying vibration being transmitted to the passenger area.	High-frequency vibrations may be transmitted directly to the fuselage structure unless design precautions are taken to assure adequate vibration isolation.	Should be in-between the pod-type and fuselage-mounted engines.
C.	*Effect on Cabin Temperature Due to Engine Location*— Engine-temperature effects on the cabin area will be non-existent.	High cabin temperatures may be a problem during ground operation unless insulation and cooling apparatus are adequate.	Engine-temperature effects on the cabin area will be negligible or non-existent.
D.	*Cabin Odors*— Except for ducting arrangements (bleed from engine for cabin pressurization), there is little likelihood for engine odors permeating through to the occupied areas of the aircraft.	Considerable care in design will be required to assure that engine compartments initially are and will remain completely sealed to prevent engine odors from entering the occupied area of the fuselage.	Same as "Pod Mounting."
E.	*Visibility of Jet Efflux*— The exhaust glow will be visible from some sections of the passenger area.	No portion of the engine exhaust will be visible to the passenger in flight.	Exhaust glow may be visible in the aft section of the fuselage.

Skyways Round Table

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about because of military interest in that type of airplane, we could be jumping quickly into a new type of operation.

"Thinking about Mr. Weeks' comments regarding the problems in trying to certificate such an airplane, isn't it possible that with the basic airframe already certificated, it might simplify the problem?"

Wm. H. Weeks: "Quite to the contrary, we have found that most modified projects are more complicated. Not only do we run into the problem of certificating the new parts, but we also run into the effect of the changes on the old parts. Everyone is most reluctant to change parts that have been approved for a number of years, to meet our present concept of standards, regulations and safety."

R. W. Rummel: *"You mean it would be practically the same as taking a new airplane and starting from scratch?"*

Wm. H. Weeks: "Yes. Turboprop installations will have an influence on all the old parts, and it might be more difficult to re-substantiate them than it would to start from scratch."

M. G. Beard: "I think we're talking rather generally on this subject. A turbine-powered transport covers three categories: the short range, now flown by Convairs, Martins, DC-3's and some DC-4's; the intermediate range flown today by the DC-6's and the *Constellations* as well as the DC-4's; and the transcontinental non-stop or one-stop airplanes.

"At the present time we don't see any really good turboprop engine for the short-range operation. Several engines are available for the intermediate classification, and there are two engines that are good for the long range. Our studies indicate that the airplane for the first class, non-stop or one-stop category must be of new design.

"The long-range field is one in which no one has operated as yet. The British are working toward it with their *Comet* 3; Boeing is approaching it with the 707. Designs are being developed right now that are economically feasible, that conserve in operations on somewhat the same levels that we are operating the present *Constellations, Stratocruisers* and DC-6's.

"In the intermediate classification, perhaps a converted airplane is a possibility *if* the correct powerplant is available. Right now we are not sure the right engine is available for that category. The advantages of utilizing what you already know, what you already have developed and worked the bugs out of, and projecting it into the future enters directly into the economics of the whole situation. If we can do that, I think we can come up with an airplane the direct operating cost of which will be lower than that of a brand new design. Tooling and production of the plane can be done more cheaply than it would for a new design which would require new tooling.

"Any brand new design has to build up a certain amount of service experience before it can be operated at the same level of reliability of the older planes. That fact combined with the lower first cost, makes it attractive to utilize an established design and modify it for the new powerplant and as a new vehicle for airline transportation. Granted that the present piston-engine designs may not be optimum for the intermediate transport with turboprop engines, it may work out that the lower first cost—the development work already having been paid for by the past sales of those aircraft—would compensate for the increased efficiency of a brand new design. However, it remains to be seen whether or not within the next few years there will be a turboprop or bypass engine suitable for airline-type operation. If there won't be, we'd better go right into new designs.

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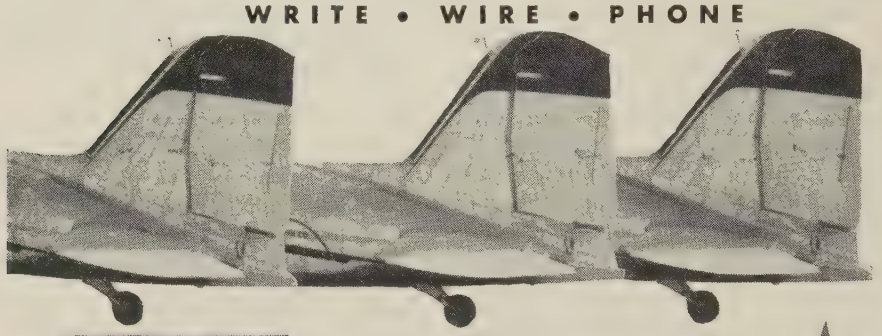

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Skyways Round Table

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"In the short-range category, it's going to be hard to beat the piston engine. That engine still has a lot to be said for it in ranges below 300 miles . . . and I'm speaking here of an airplane that averages 150 miles per hop. On such short hops it is hard to get to the altitudes at which any of the turbine-powered transports have to get in order to operate economically."

Capt. F. E. Davis (*Chief Engineering Pilot, Eastern Air Lines*): "I'll have to both agree and disagree with Dan Beard's comments. I think in the operation of any of these new type airplanes, either a turboprop or a turbojet, a totally new design is called for. We can't make a turboprop airplane out of any of the transports we are presently flying and come up with an efficient airplane. It's perfectly proper for us to use the current transports as test beds for turboprop installations, but to try to make an operational airplane out of one probably would be a waste of money all around.

"In the matter of short-range aircraft, I thoroughly agree with Dan. A turboprop airplane could never do what our present airplanes do. For example, Eastern's short-haul trips average 30 minutes, and on a 30-minute hop it would be impossible to get a turboprop up to an altitude where you begin to get efficiency out of it. I think we're going to have piston-engine airplanes around for a long while."

A. F. Dernbach (*Sr. Project Engr., Hamilton Standard*): "Recent statistics indicate that the commercial airlines now are carrying something like 80% of the total traveling public making trips of over 1,000 miles. In other words, air travel has taken over most of the long-haul trips. In the medium or short-haul, it appears that only 30 or 40% of the traveling public uses air travel, all of which indicates that the potential future growth of the airlines lies in the short and medium-haul field.

"Mention of the short and medium-haul field brings to mind one word remarkably absent from all conversation regarding turboprop or turbojet; that word is 'flexibility' . . . the ability to operate from 100 to 1,000 miles in all kinds of weather.

"There isn't any question but that the piston engine is supreme in the very short range, and we all seem to agree that the turboprop is best suited for the medium ranges. But there is much controversy over the relative merits of the turboprop *vs.* the turbojet for the premium transportation long-haul operations. This brings up the question of whether any airline can afford to support all these different types of aircraft in its fleet. It, therefore, becomes a matter of selecting an airplane which will operate over widely varying stage distances at maximum over-all efficiency What kind of airplane do the airlines need if they can't support a piston-engine fleet for 200-mile legs, a turboprop for 500-mile trips, and a turbojet to operate the long-haul 1,000 to 5,000-mile trips? The airlines need an air transport with a high degree of flexibility, one that does not necessarily provide optimum performance in each category but which imposes a minimum of economic penalty on an actual day-to-day kind of operation. It probably boils down to the fact that an airline should have two types of aircraft in its fleet—the long-haul premium sort of airplane which may very well be a turbojet but which could equally or better be a turboprop, and a turboprop which offers a good compromise between the piston-engine transport and the turbojet.

"On a day-to-day operation, I believe we all recognize the fact that our biggest growth potential lies in the short and medium-range field hauling both passengers and cargo, and that the turboprop will probably be the airplane we are looking for."

R. W. Rummel: *"It would be very difficult, Mr. Dernbach, to disagree with your thoughts on economics. However, one of the things industry presently lacks, but which the military may shortly provide, is actual operation with large turboprop transports. Whether or not these military transports are optimized as economical vehicles would have no significant bearing on the value of them to industry at large by providing, through their operation, a background of useful information. The industry will be benefited by the military program."*

Col. John C. Layson (*Chief, Requirements & Development Div., DCS/OPS, MATS*): "The purpose of the turboprop test-bed projects is to obtain operational experience and, because of economic considerations, it was decided that currently designed airframes were adaptable to such experiments. As soon as the preliminary flight tests are completed, we plan to put those aircraft on operational runs to gain experience flight-wise, maintenance-wise and from a traffic standpoint.

"To go back to Mr. Beard's three categories of short, intermediate and long-range requirements, we are pretty well satisfied with the current equipment as far as the short- and intermediate-range requirements are concerned. Our primary requirement now is for a long-range transport.

"As Gen. Smith outlined in his paper presented to IAS recently, we are thinking in terms of 3500 miles at payloads of something like 50,000 or 100,000 pounds and possibly something in the vicinity of 500-knots speed."

Don Elder: "You have indicated that we are on the threshold of gaining new experience in the operation of turboprops which are relatively new to both the Air Force and the industry. The turbojet, however, has been flying with the Air Force for many years. There was a time when many of us thought that jet would be the powerplant for the Air Force in the future. Can you give us any information on airline-type operational experience with the USAF turbojet airplanes?"

Col. Layson: "There just isn't any. We have gained considerable experience with the turbojet engine in the bombers and fighters, but not on a scheduled airline-type intercontinental operation.

"To amplify this turboprop test-bed idea, we feel that all we can get is information on the engines and the propellers."

Don Elder: "Is it that you do not hold out much hope for the airline operators as far as the use of turboprops in the near future is concerned?"

Col. Layson: "Not with present-day aircraft."

A. F. Dernbach: "Gen. Smith expressed a desire to have a specialized airplane for each specialized mission. Unfortunately, the cost of such a program is prohibitive. Having worked for the Air Force for 13 years, I just don't believe he's going to get this specialized airplane for each special mission, nor do I think the airlines can afford a specialized airplane for each of its missions—short haul, medium haul and long haul. Possibly the need could be broken down into a cargo airplane and a passenger plane. In the final analysis and facing the economic realities of life, you have to buy an airplane which is, at best, a compromise of many requirements. Again, this leads to the word which is never mentioned in theoretical studies but which becomes of almost over-powering importance . . . 'flexibility' . . . to be able to take the airplane you have and that you can afford to operate, and use it as circumstances dictate on a day-to-day basis."

Col. Layson: "General Smith did not express a desire to have special aircraft for each specialized mission. However, he did point out the need for two distinct types of transports for the intercontinental long-range mission. One for the basic cargo-carrying job, and another for the high-priority, specialized, air-express, passenger and air-evacuation mission. This points up only two aircraft and not aircraft for every specialized mission. General Smith went on to say that he believed that the turboprop would fit into the all-cargo aircraft and the turbojet for the long-range passenger, air-evacuation, and high-priority air-express aircraft. That seems reasonable."

R. W. Rummel: *"One of the limitations imposed on the design of a sensible airplane is the availability of powerplants. Perhaps one of the engine manufacturers would comment on that. Dr. Walker?"*

Dr. C. J. Walker: "We have come through a 12-year period of development of turbine engines of one kind or another. Ten years ago I was spending 100% of my time working on turboprop development. The engine in the turbine group which has received the major share of attention, however, has been the turbojet. For military reasons, turbojet-engine development has been pushed very hard. The ducted fan and the turboprop have received a relatively small amount of attention.

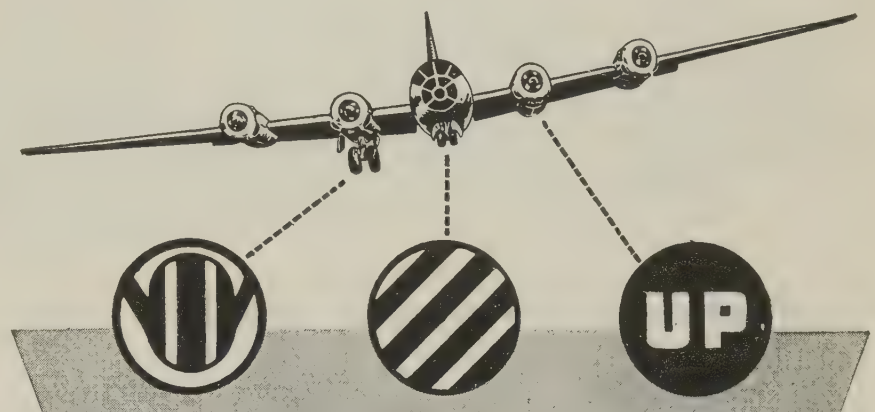
"The progress made over this 12-year period has been substantial. Twelve years ago we were working on the development of jet engines with 1200 pounds thrust. Today, however, you can pick up any issue of *SKYWAYS* and find out that we are working on engines with 15,000 pounds thrust. That's more than a 10 to 1 improvement in 12 years. Also, the specific fuel consumption of turbine engines has been cut in half, and despite the increased size of the engines, the specific weight has gone down by one-third while the life and reliability of these engines has gone up steadily. I think you are all taking a very shortsighted view if you look at the engines available today and base your estimates of the future of aircraft transportation on those engines.

"Of necessity I must and do have a great degree of sympathy for Mr. Dernbach's viewpoint. Flexibility is a major requirement. There is an intermediate-type engine between the turboprop and the turbojet that has a great deal of flexibility, and that's the turbofan-type engine which possibly can be developed for both a high and a low subsonic Mach number, with a wide range of flexibility.

"It has been strongly implied here that the commercial aircraft industry may not be able to support a large variety of engines and may, therefore, have to settle for one or two types. If engine development continues at the same rate it has over the past 12 years . . . and I see no reason why it shouldn't . . . then the implications are very serious. Ten years of rapid change may result in the early obsolescence of a large number of airplanes and considerable expense for the development of new types of engines and airplanes because of this early obsolescence.

"There are developments going on today in boundary layer control, for example, that this is the moment for rapid acceptance design. I don't believe any of us are adverse to change, but neither do I believe that this is the moment for rapid acceptance of any particular type. Certainly, the Air Force program of testing these various types of engines in actual service is a real contribution to the development of commercial aviation. I believe, however, that this is the time for a broad, long-range look, not just a short-range look or a look at conversions of present-day aircraft. Consider what can be done in the next 10

(*Continued on page* 48)



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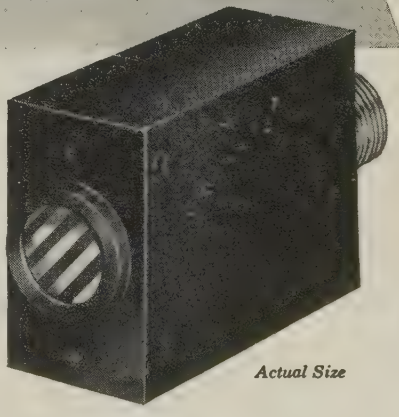

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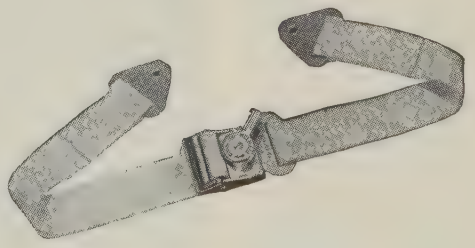

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Skyways Round Table

(*Continued from page* 47)

years, and then put your bets on what looks best for the long pull."

R. W. Rummel: *"In the past, our commercial engines have been a direct outgrowth of military powerplant development. As I understand it, Dr. Walker, you believe that the military and commercial engine-design criteria will remain more or less parallel in the future as they have in the past, rather than diverging as some believe and have so expressed."*

Dr. Walker: "I have that general feeling, yes. The by-pass engine is potentially a good supersonic as well as subsonic engine, and as such may be compatible with both the military and the commercial airline needs. The trend in jet-engine development is in the direction of higher Mach numbers. This is a continuing process and I don't think that it will be changed in the near future. It seems to be growing away from the commercial transport needs into a strictly military field."

Robert L. Wells (*Ass't Chief Engr., Aviation Gas Turbine Div., Westinghouse*):

"There was a time when the primary requirement imposed on the jet-engine designers was to build a bigger, more powerful engine. Today, we're going back to some of the smaller size engines to incorporate into their designs the skills that have been developed over the past 10 or 12 years. This refinement of design has enabled us to produce a more economical powerplant which now can be considered for use where some of the earlier engines could not be.

"One thing to keep in mind in applying an engine to a commercial design is that after you pass the first qualification test there is still much work to be done to add to the engine life so that the commercial people can use it economically."

R. W. Rummel: *"Gentlemen, time is passing and I'd appreciate it if you would now devote your attention primarily to the problems associated with the development of operational applications of turboprop and turbojet engines in the short-haul, feeder-type or executive transport. Helicopters and convertiplanes can also be included."*

T. M. Sullivan (*West Coast Representative, Fairchild Engine Div.*): "Small-engine development has lagged somewhat in accomplishment, probably from an economic standpoint. Economics of engine development or engine operation or maintenance generally assume more important proportions in the small-engine field. Military requirements have demanded that major effort be applied to larger output engines. Engine development today in the small-engine field is such that durable engines are becoming available in the turbojet category and will be available in the shaft-turbine field.

"It would seem to us to be very practical and entirely reasonable to apply the gas-turbine engine to business-type aircraft. There is no reason why the gas turbine is not practically suited to high-performance small aircraft, including the helicopter."

R. W. Rummel: *"Mr. Davis said earlier that the altitude characteristics of turbine engines militate against the use of those engines in short-haul aircraft. Do I understand you to mean that there are other compensating factors?"*

(*Continued on page* 50)

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Air Industry Passes Autos in Employment
LOS ANGELES, Calif., June 24 (AP) The aircraft industry is the largest manufacturing employer in the United States.
The Aircraft Industries Assn. reported Thursday that America's plane manufacturers have surpassed the auto industry in total manpower. The car industry long had been the leader.
Aircraft manufacturing now employs 823,000, compared with 786,000 for automobiles, the AIA reports. The figures are from the federal bureau of labor statistics.

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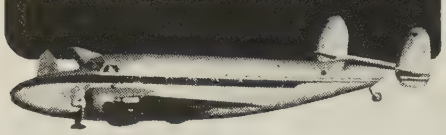

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Skyways Round Table

(*Continued from page* 48)

T. M. Sullivan: "The principles that apply to large aircraft in the matter of range, apply also to small aircraft. Long-range aircraft would profit by gas-turbine propulsion in offering higher performance. Applying the gas turbine, particularly turbojet, to short-range small aircraft would be no more economically desirable than it would be in large aircraft. However, the high performance attainable regardless of range could well justify the selection of turbine engines."

R. W. Rummel: *"Mr. Sullivan, can you tell us what Fairchild is doing in the small-aircraft engine field?"*

T. M. Sullivan: "For some time we have been working with small turbojet engines. We are currently manufacturing production quantities of the J-44, a 1,000-lb thrust engine used primarily in non-piloted applications. However, design and development work is proceeding to adapt it to other applications and somewhat higher power requirements. We are interested in turboprop work but are not in a position to discuss it at this time."

R. W. Rummel: *Let's give attention now to our third and last category, the purely operational aspects of turbine engines, including such phases as maintenance, communications, holding patterns, etc."*

Robert L. Wells: "One thing I would like to mention in connection with the life of the turboprop engine is that the hot-end parts of the engine are designed primarily for creep life due to high temperatures. Depending on the application, most of our past experience has been the military where high performance is eagerly sought, and the design is for a life of a different order than the extremely long life the commercial operators want. Those parts designed for creep stresses can have their life extended by reducing operating temperatures.

"Overhaul of the turboprop or turbojet engines themselves need take only a short time. In the past we have had engines come in for complete overhaul and we have had them out in four weeks. I realize that in commercial use the amount of time you tie up your capital investment is extremely important. Therefore, as far as time in the overhaul shop is concerned, the possible goal that is attainable looks to me to be quite low and should be attractive to airline people."

R. W. Rummel: *"One of the areas of increased maintenance because of complexity, particularly on turboprops, is power controls. Mr. Brady, would you comment?"*

George W. Brady (*Dir. of Engineering, Prop Div., Curtiss-Wright Corp.*): "I don't believe there has actually been an increase in powerplant complexity of turboprops. Originally, the problem of controlling a turboprop engine was not always fully understood and there were some difficulties with control in the earlier days of its development. However, over the past three or four years the various engine and propeller manufacturers have successfully solved the problem of control, and you can now actually operate the turboprop engine in ways that piston engines can't be operated. For example, we set a goal of being able to get up to take-off power from an approach power setting in less than a second. That is being achieved on various installations.

"Also, the propeller has been called upon to take care of engine failures. That has been done in the case of reciprocating engines for the past 12 or 14 years, but with the turboprop engine it is being done automatically so that there is no chance of a pilot feathering the wrong propeller, in case of an emergency in flight on a dark night. The system with the turboprop engine is being worked out so that the right prop will be feathered automatically and it will be done in such a way that, if it is only a momentary power interruption, the powerplant will go right back to a normal constant speed operation.

"These and several other things have been worked out in the development of the turboprop control system, and it is being done without undue complexity.

"We don't see any reason why overhaul periods for turboprop propellers will not reach the same level as they are with piston engines. I believe this is somewhere in the vicinity of 1600 hours.

"One of the questions that came up in the earlier part of this discussion is what is the best powerplant for the high-speed cruising range. Gen. Smith of MATS defined it as the turbojet. I see no reason why a good turbojet airplane can't be built that will operate up there and offer the range they've been talking about, namely 2,000 or 3500 nautical miles. However, I think it is entirely possible that a better and more efficient airplane using turboprop powerplants also could be built.

I'd like to mention some figures that were developed from a study we made.

"We set up a hypothetical pair of airplanes, one a turboprop and the other a turbojet, designed to carry between 90 and 100 passengers and to cruise non-stop New York to San Francisco at 550 mph. Looking at the fuel required for the operation of one plane over a year's period, it looked to us as though it would take about 1,000,000 gallons more per year to operate the turbojet than the turboprop. That's a sizeable figure and is one that would suggest further study of the turboprop installation."

R. W. Rummel: *"As I understand it, you feel that whatever additional complexity there may be is justified, and the overhaul periods can be equivalent to what we have today for reciprocating engines."*

A. F. Dernbach: "I agree with George generally. We have built a great many jet-engine fuel controls at Hamilton Standard, and I believe the propeller control is more simple than the jet-engine control.

"If you add two equally complex systems together, you don't have a more complex system. You have more of the same degree of complexity but not necessarily a higher degree of it. In reality, as the turboprop was developed many feared that control was going to be the bugaboo. However, those bugaboos have largely disappeared and the system is basically not complex at all. In fact, compared to such things as the autopilot system on the airplane, or some radar installations that are considered acceptable, it is relatively simple. We are developing a basic, hydro-mechanical type of control which will be simple and easy to maintain."

R. L. Bell: "With regard to George Brady's comments on the economics of the turboprop *vs.* the turbojet, we made some

(*Continued on page* 56)

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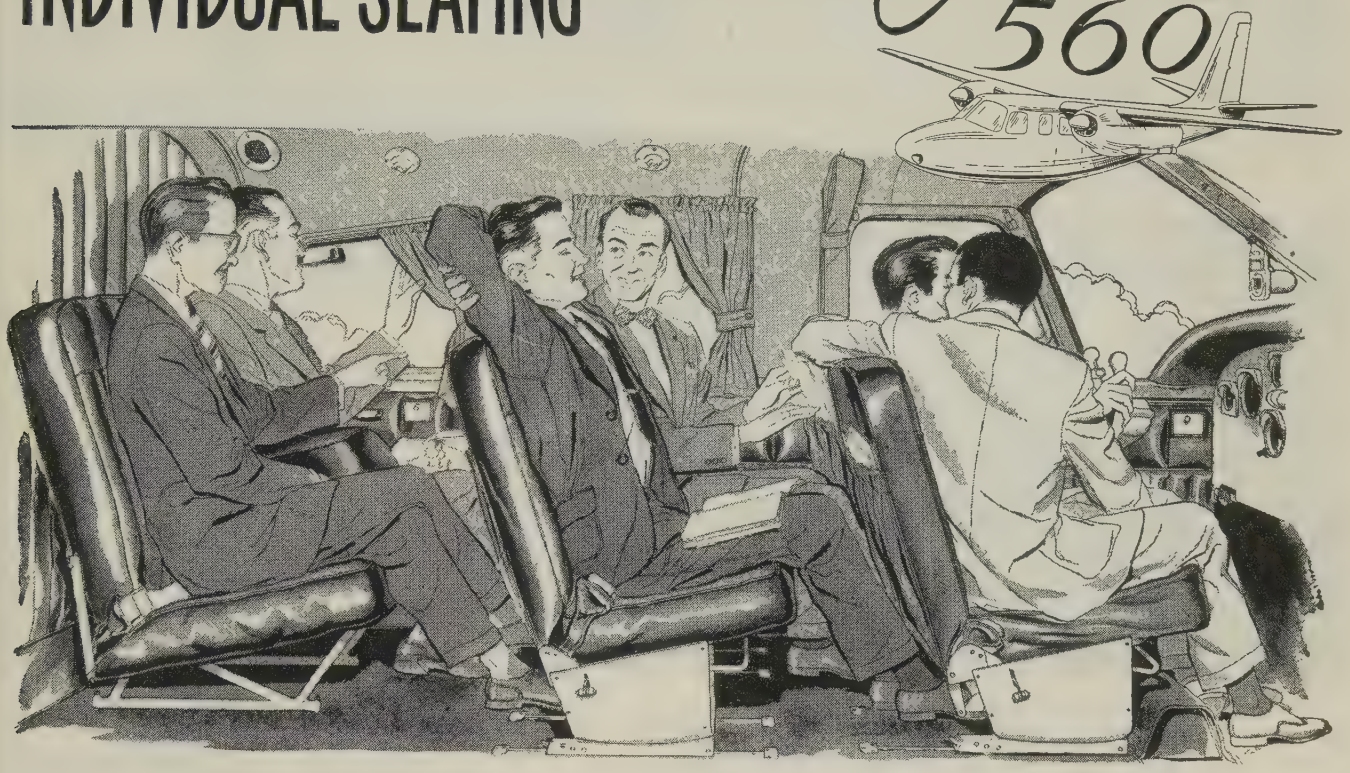

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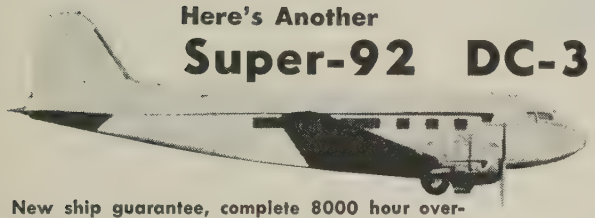

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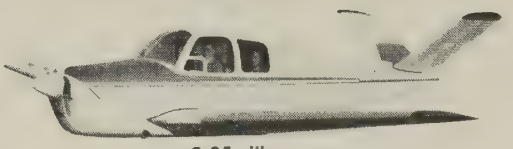

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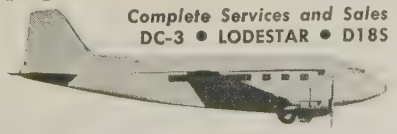

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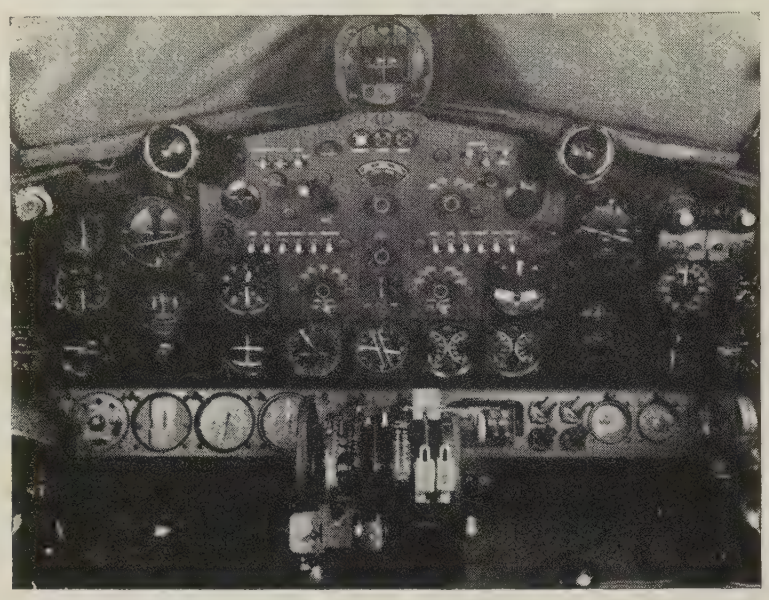

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Skyways Round Table

(*Continued from page* 50)

economic studies at Boeing and we have had a difficult time trying to reconcile a turboprop, *circa* 1965, with a turbojet of 1958.

"At this point in our experience at Boeing, we are having fewer maintenance difficulties with the turbojet engines than we are having with the piston engines on the B-29 and B-50. The jet engine life is much better."

A. F. Dernbach: "I think the added maintenance on such airplanes as the B-50 compared with the B-47 is due to the powerplant and not the propeller. Our commercial propellers now run upwards of 3,000 hours between overhauls."

Don Elder: "In regard to powerplant operational costs, I think we have to look at the over-all picture of every application of the turbine to a transport airplane. There are applications in which powerplant operational costs are not vitally significant. Some time ago we briefly mentioned application of the turbine to a personal or executive-type airplane. We know that when three or four businessmen get into their company-owned *Learstar* or what-have-you, and go cross-country, they are not doing this on a very low cost-per-passenger-mile. Yet these businessmen find it economically advantageous to have their own aircraft rather than relying on other forms of transportation. It's more flexible . . . they can arrive and depart at will and, oftentimes, at terminals not easily reached by the scheduled airlines. In cases such as this, if people can save time by using a turbine, they will gladly pay for it.

"Another application where the operational costs may not be a governing factor is on aircraft for short-haul work. As we cut down the length of the haul, we cut down the amount per trip that is spent on operating the powerplant and we increase the relative expenses of maintaining terminals and spending money in having the airplane on the ground between flights. Here is where we will probably see the use of the helicopter, perhaps with reciprocating engine or with the shaft-turbine engine. In this application, we probably would need a shaft turbine of low to medium power.

"Looking at the turbines that are available, we can't help but realize that the military applications have pretty well controlled the power and operating characteristics that are going to be available for commercial applications. I think we can say that the industry as a whole has done a good job of meeting military requirements. If the commercial transport industry is going to rely on the military services to develop powerplants, it will have to find markets and applications to fit the engines."

M. G. Beard: "When I remarked earlier that the piston engine was best for short-range operations, I was referring to the present time. I firmly believe the engine builders eventually will develop a suitable turbine-type powerplant for the short-range airplane. Certainly turbine development is still in its relative infancy.

"One engine manufacturer made a special effort to dig out of the military records facts and engine data on a type of operation similar to some types of commercial operations. When we looked at the figures, we took heart because they didn't look too bad. In fact, they led us to believe that the turbine powerplant would not be difficult to operate on the airlines, and that it would be reliable and durable.

"With the tremendous amount of engineering being put into the whole field of turbo powerplants, it is bound to improve rapidly. But we have to start somewhere, and the airlines have to know what they are going to start with. The airlines have to be convinced that they can start somewhere within the threshold of the record for safety and reliability of scheduled operations that has been developed with the piston-type engine."

Capt. Davis: "There are development problems that come up in addition to those of engine development. For example, one of the problems has to do with instrumentation. An aircraft that is going to fly at 600 mph requires different flight instrumentation than one that flies 100 or 150 mph. This is particularly true with regard to the attitude instruments.

"Other developments also are necessary. The passenger's desire is to get from Point A to Point B within a certain specified time. However, his time in transit starts when he gets to the airport and ends when he leaves the airport. At the present time, a passenger often has to stand around an airport in the neighborhood of 30 minutes. On a 1200-mile flight, a jet transport will give an increase in speed over present-day aircraft of some 70%, but the passenger only increases his speed from the time he gets to the airport until the time he leaves the terminal airport by about 45%. We are losing a lot in the ground time, so something must be done to speed up this portion of the operation."

R. W. Rummel: *"Gentlemen, many thanks, indeed, for your interesting and valuable contributions to this discussion.*

"I've made a list here, a sort of summary impressions of items that we seem to agree on. They are:

1. While the engine test-bed turboprop transports are not necessarily optimized with respect to engine-airframe matching, these aircraft can well prove to be economically superior to their piston-engine powered counterparts.

2. It appears that special Federal Regulations to suit turbine-powered aircraft will be evolved slowly, depending upon need.

3 A great deal of beneficial knowledge and experience will be obtained through Military operation with new large American turboprop transports.

4. Military and commercial engine-design criteria need not necessarily diverge in the future and may well remain common.

5. Both piston and turbine engine will have a place in executive or feeder-type aircraft in the future.

6. Additional exploratory and development work needs to be done before large-scale commercial jet operations will be fully practical, including ground handling, traffic control, flight planning, etc.

7. Overhaul periods for turbine engine and prop are comparable to reciprocating standards. Reliability of operation has been achieved in tests, thus indicating scheduled operation of turboprop and turbojet is economically feasible.

"Gentlemen, again, many thanks for your cooperation."

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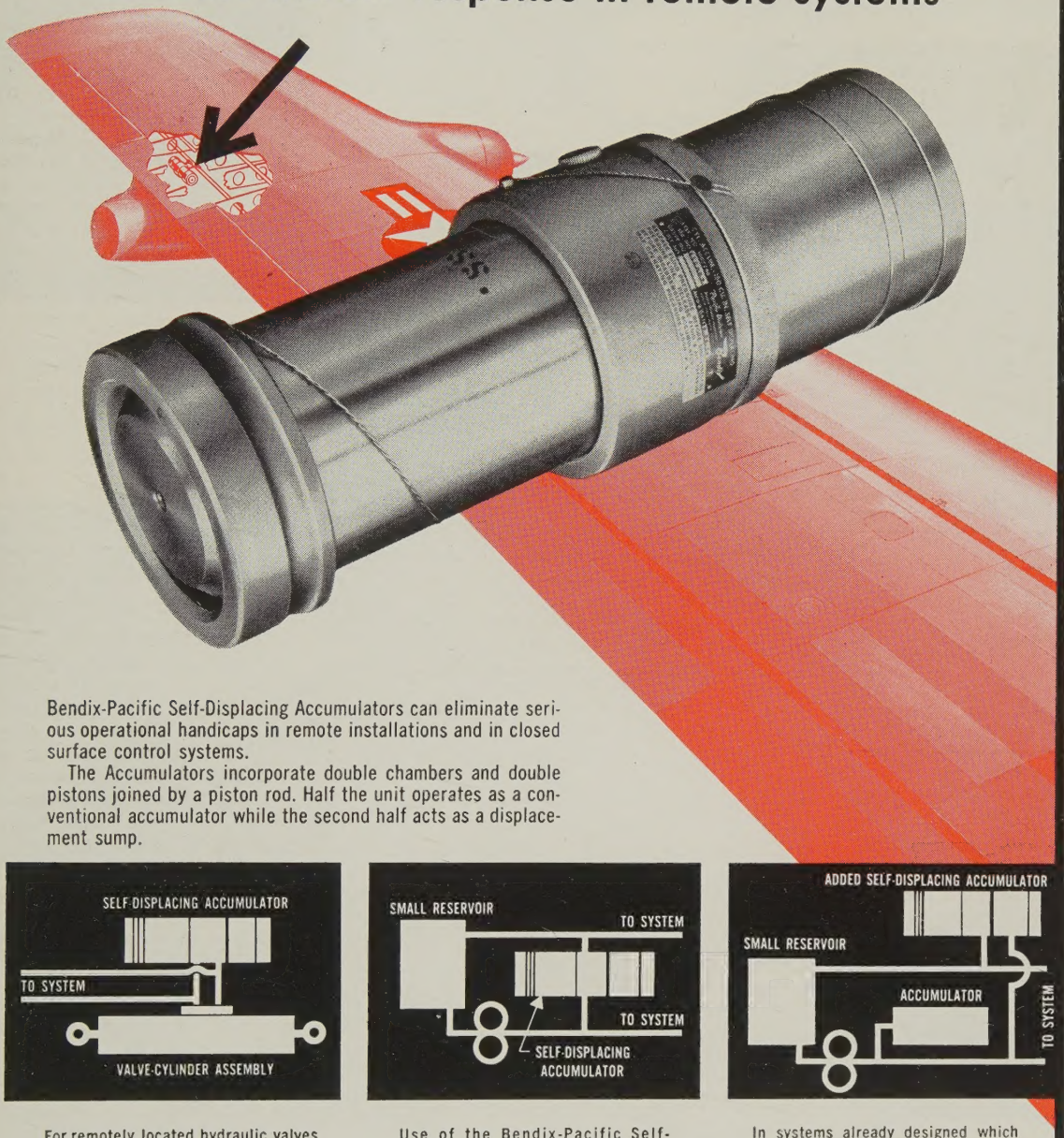

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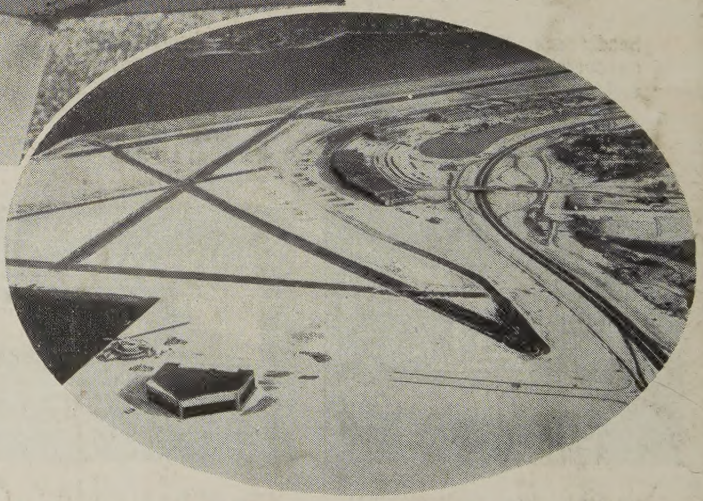

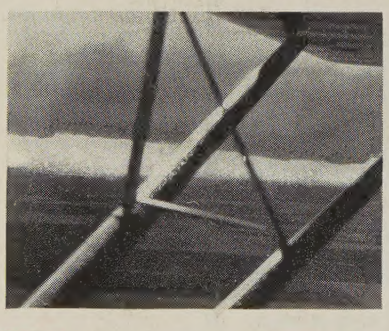

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